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A QUARTERLY ECONOMETRIC MODEL OF THE CANADIAN DAIRY INDUSTRY

(Working Paper 4/90)

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(Working Paper 4/90)

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A QUARTERLY ECONOMETRIC MODEL OF THE CANADIAN DAIRY INDUSTRY

HISTORY OF ECONOMETRIC MODELLING EFFORTS

Much of the early econometrics modelling work on the Canadian dairy industry focused on analysis of demand for fluid milk and processed dairy products (Shefrin et al., 1967; Perkins et al., 1969; Lu and Marshall, 1973; Hassan and Johnson, 1976). The first attempts to build an integrated industry model were made in 1969 by the Planning Secretariat of the federal Treasury Board, which was interested in analyzing the social welfare effects of the then recently introduced federal and provincial institutional arrangements for industrial and fluid milk shipments, respectively. This integrated industry model contained supply, demand, price, stocks, international trade and policy blocks, as well as consumer and producer surplus, and net social welfare blocks. Estimates were made on the basis of annual (calendar year) data series.

The Treasury Board model was transferred in 1972 to Agriculture Canada, where interest centred on forecasting and policy evaluation uses of the model for guiding overall policy objectives and the setting of policy instruments such as quota levels, support prices, producer subsidies, levies, etc. (Stonehouse, 1979). Considerable refinements and extensions to the Treasury Board model were made by Sahi and Harrington (1974), and by Stonehouse et al. (1978).

Certain biophysical attributes of and the institutional arrangements for the dairy industry prompted the development at Agriculture Canada of a new generation of econometric models,

starting in 1977. Natural breeding of northern hemisphere bovines in the summer, combined with relatively low-cost pasture feed in summer, have historically caused seasonal fluctuations in milk shipments. In contrast, demand for milk and dairy products exhibits relatively little seasonality. The policies and institutional programs in place for dairy are designed to ensure that domestic demand for high quality dairy products is fully met at prices that assure efficient producers of a reasonable return to resource inputs (Canadian Dairy Commission, 1966). In setting quota, support price, levy and other policy instrument levels, allowance must be made for seasonally fluctuating milk supplies in relation to relatively constant demand seasonally. Moreover, the need for estimating and forecasting policy-makers' responses to changes in market events was recognized. The new generation of models sought to meet these needs through specifying policy instruments as endogenous variables, and by specifying all equations on a (calendar) quarter basis (Rausser and Stonehouse, 1978; Stonehouse and Rausser, 1981).

An additional level of complexity and sophistication was added in the late 1970s by conjoining the quarterly dairy econometric model with quarterly econometric models of other Canadian agriculture sectors, such as grains and oilseeds, red meats, and poultry. Explicit linkages among the various sectors were incorporated within a single comprehensive modelling framework (Food and Agriculture Regional Model, or FARM), so that "joint

estimation" and simultaneous forecasting across all sectors became possible (Agriculture Canada).

PROBLEM SITUATION

Although on-going refinements and modifications have helped keep the quarterly dairy model current and operable during the 1980s, there has been no extensive and critical review of the FARM version of the model since 1983 (Agriculture Canada, 1980-1986). Meanwhile, structural changes have continued to take place in both milk shipping and milk processing sectors of the industry; consumer tastes and eating habits continue to change; and policy developments have continued to fine tune the instruments used to regulate supply, support producer incomes and dispose of surplus products. These changes need to be accounted for in any model whose explanatory and forecast results form the basis of official short- and long-run projections and policy evaluations.

A second problem area concerns the data base and the information needs of the industry, taking into account institutional factors such as the dairy year. Dairy industry data have traditionally been collected by Statistics Canada on a calendar year, quarter or month basis. Since the establishment of a new dairy year (August 1 to July 31) in 1979, many data series are compiled on a dairy year or quarter basis, as well as on a calendar period basis. The dairy industry's needs for forecast and policy evaluation information are more appropriately met on a dairy year or quarter basis. It was therefore deemed undesirable to have

the econometric model's structure and attendant data series organized along calendar time period lines.

A third problem element devolved from the many inherent complexities of the FARM version of the quarterly dairy econometric model. To meet the on-going forecasting and policy evaluation needs of dairy industry participants and their policy advisors, information on a broad, aggregate basis is preferred over highly detailed or disaggregated results.

For example, it was decided that it would be sufficient to provide the industry with information about domestic demand for broad groups of dairy products (e.g. fluid milks and creams; butter; skim milk powder; cheeses; other dairy products), rather than in the present disaggregated fashion, with demand specified for two different types of cheeses, and for several different sub-categories of "other" dairy products. Similarly, the milk supply side is presently modelled through specifications of dairy cow and heifer numbers and milk yield per animal. It was decided that a simplified, streamlined specification would be both adequate for industry purposes and preferable.

OBJECTIVES

The overall objective is to refurbish the existing quarterly econometric model in order to provide dairy industry participants and their policy advisors with more relevant, more useful and more helpful information. In particular, the specific objectives are to:

1. critically review the overall structure of and the individual equations in the existing model, and to reorganize the structure and respecify the equations where necessary, the better to reflect the current and prospective state of the Canadian dairy industry;

2. reorganize the data bank that supports the econometric model to conform with the Canadian dairy industry's needs for information on a dairy time period basis;

3. empirically test the appropriateness and potential applicability of the restructured model and data bank.

THEORETICAL FRAMEWORK FOR ANALYSIS, FORECASTING AND POLICY EVALUATION IN THE CANADIAN DAIRY INDUSTRY

A comprehensive model of the Canadian dairy industry would be one able to provide analyses and forecasts of all sectors and all major parameters. To meet the industry's needs and those of its advisors, a comprehensive modelling approach is considered superior to one that examines only some sectors or major parameters. The preferred comprehensive model should then include sectors for milk supply, milk allocation among alternative end-product uses and processing, stock holding, domestic demand for milk and processed dairy products, net international trade and prices at farm-gate, wholesale and retail levels.

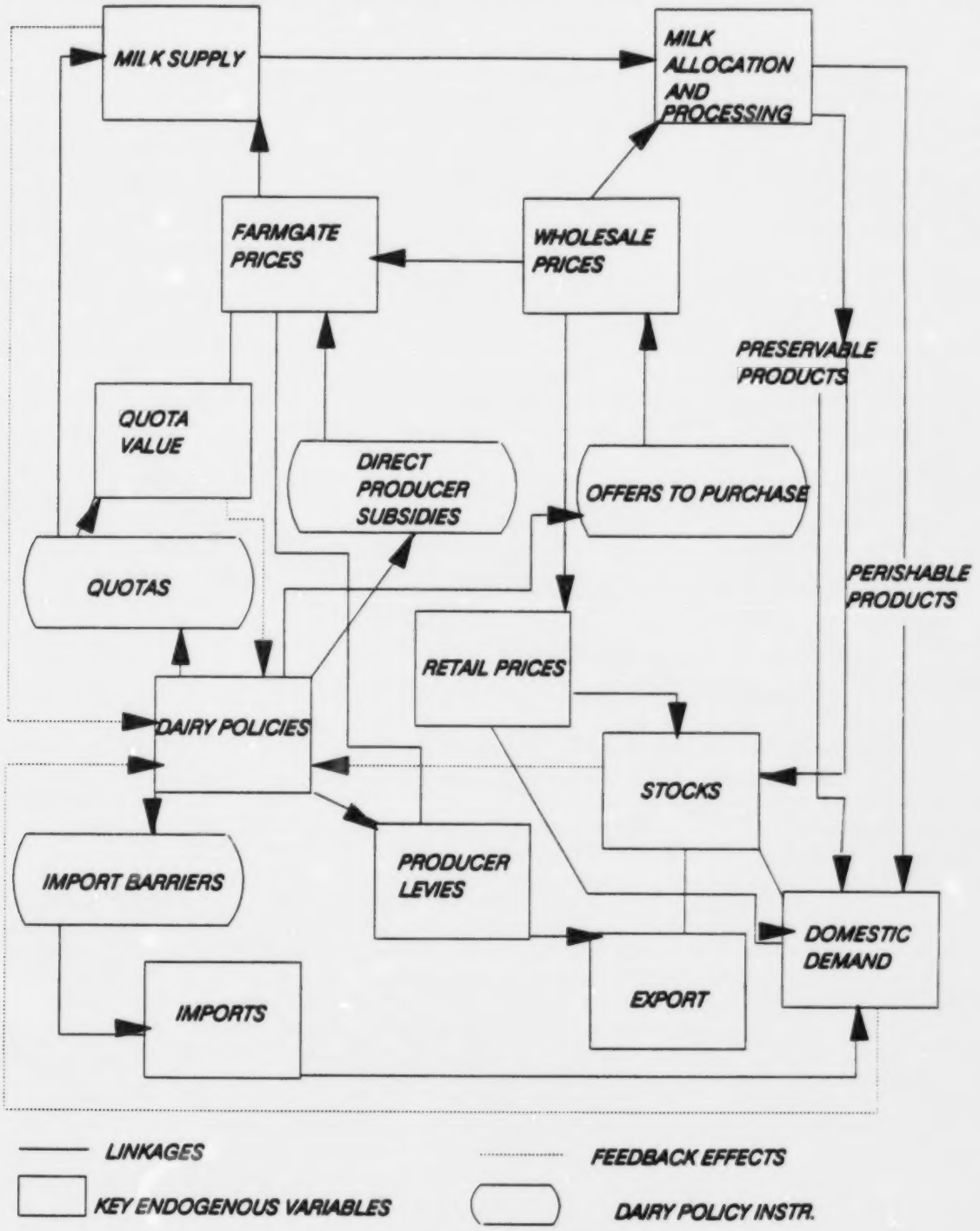
Because of the overriding importance of the institutional arrangements affecting the Canadian dairy industry (see, for example, Stonehouse, 1987), these should also be included in a policy sector. Linkages should be established not only among these sectors within the dairy industry (Figure 1), but also among the dairy industry and other industries within the agricultural sector of the economy.

These inter-industry linkages should include those between dairy and the beef cattle industry, which absorbs much beef and veal sourced in the dairy industry, and the feed grains and oilseeds industries, which furnish much of the nutritional requirements for the dairy herd. Feedback effects on the policy-setting mechanism should be explicitly recognized by making key policy parameters endogenous variables.

Milk Supply Sector

Raw product is supplied to the marketplace in two forms - fluid milk and farm-separated cream. Fluid milk has no constraints placed on its use in any of the fluid or processed dairy products. Farm-separated cream's uses are confined to butter or ice cream. To the traditional variables (of own price, price of competing product, cost of major inputs and technological change) thought to affect the farm supply of milk and cream should be added government policy variables. The key policy variables are quotas, international border protection, direct producer subsidies, and

FIGURE 1: OVERVIEW OF DAIRY INDUSTRY PARAMETERS AND LINKAGES



support prices for principal processed products which feed back into farm-gate prices for raw product (Figure 1).

Quotas are the instruments used to limit farm supplies of milk and cream to the aggregate amount that can be reasonably expected to be absorbed by domestic demand for fluid milk and processed dairy products, plus commercial exports of processed products. Quotas were found to be necessary relatively early in the governmental support experience with the dairy industry because of a) indirect guarantees of a market for raw product through an offers-to-purchase program; b) the setting of farm-gate prices at levels attractive to producers relative to prices for competing farm products; and c) stability of farm-gate prices which totally obviated market (price) sources of risk and conferred a feeling of greater security relative to competing product lines (Stonehouse et al., 1978). Complications arise because three different types of quota are issued to cover shipments of fluid milk, milk for processing into dairy products (industrial milk), and farm-separated cream. Moreover two levels of government are involved in quota issuance - fluid milk quotas are the sole concern of provincial governments; industrial milk quotas are issued by the Canadian Dairy Commission to each of the provinces, which in turn allocate quotas for milk and cream to producers within their boundaries (for details, see Stonehouse, 1979, and Stonehouse, 1987). A further complication stems from joint quota holding. Typically, fluid milk shippers also hold industrial milk quota, and many cream shippers also hold industrial milk quota (Stonehouse and

Tabi, 1988). Theoretically a shipper may hold all three types of quota, but in practice, fluid milk quota and cream quota are generally owned by different subsets of producers.

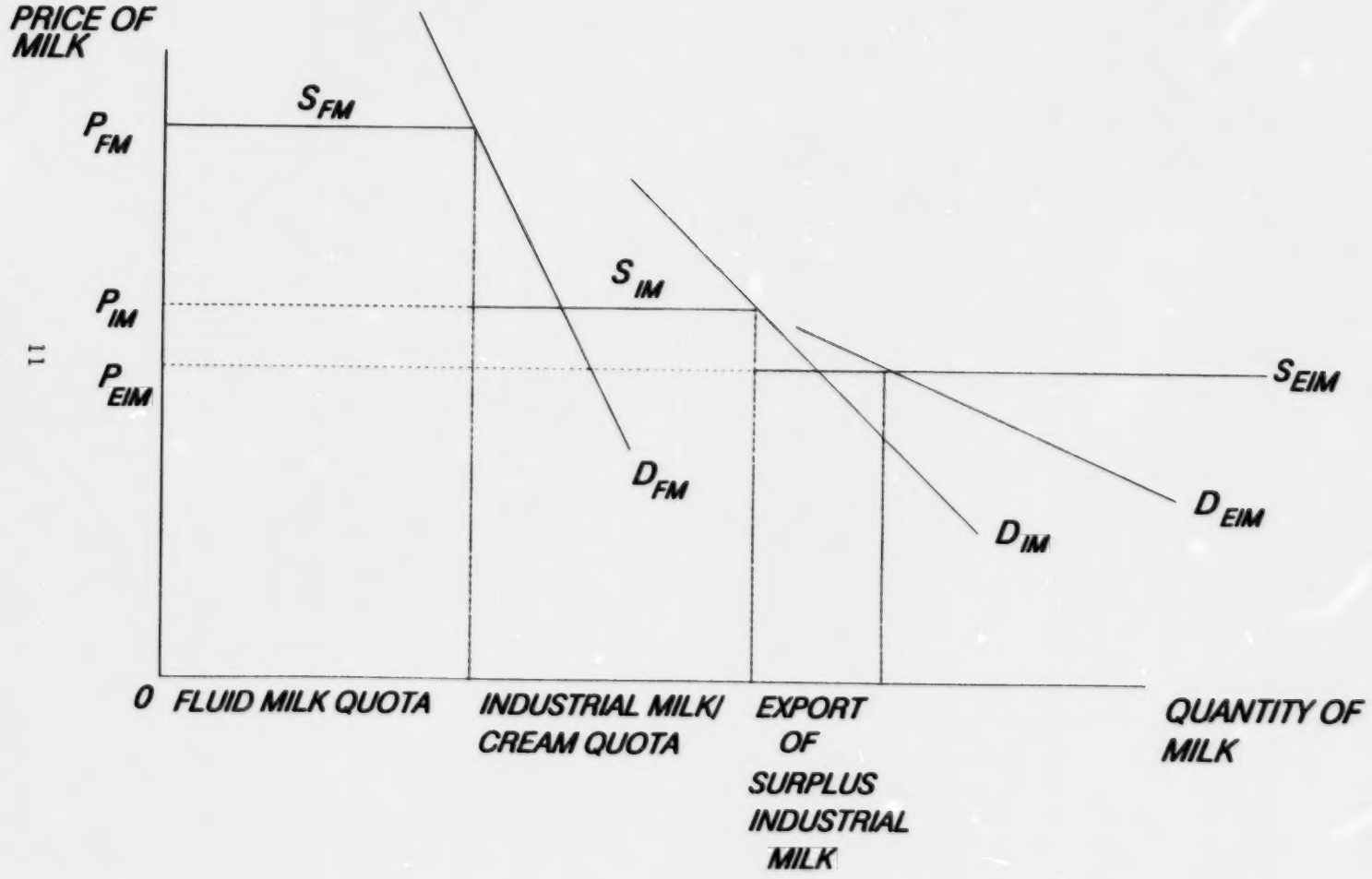
International border protection is afforded by means of import embargoes (butter), import quotas (specialty cheeses), and import tariffs (most other dairy products). Such measures are required to prevent imports of tariffs dairy products from undermining the supply-management and support-price policies.

Government financial support for dairying at the federal level operates through direct producer subsidies and through guaranteed minimum (support) prices for butter and skim milk powder jointly produced from industrial milk and cream residual to processors' requirements for cheeses and other dairy products. Together, the subsidies and support prices form the basis of a "target return" on industrial milk and cream at the national level. Each province uses the target return as a reference base for setting industrial milk prices (by class according to end use), cream prices, and fluid milk prices for all product shipped within its borders (for details, see Stonehouse, 1979, and Stonehouse, 1987). Premiums received by producers for fluid milk ensure that fluid quotas are always filled first, to the extent needed to satisfy demand for fluid milk and cream products. Second priority is given to product covered by industrial milk and cream quotas, with any residue beyond domestic demand and commercial export requirements receiving the industrial milk/cream price net of an "over-quota" levy. This three-tiered supply system for three price levels is depicted

graphically in Figure 2, with both supply of fluid milk, S_{FM}, and supply of industrial milk and cream, S_{IM}, shown to be perfectly elastic at their respective supply prices, P_{FM} and P_{IM}. Supply of exported industrial milk (in the form of products), S_{EIM}, is also shown to be perfectly elastic because of Canada's small role, and therefore price-taker status in international markets. The price difference (P_{IM} - P_{EIM}) is equal to the over-quota levy, an amount needed to export industrial milk surpluses into lower-priced international dairy product markets. The demand curves, D_{FM}, D_{IM} and D_{EIM}, represent demands for milk derived from final demand for dairy products.

"In-quota" levies are another government policy instrument whose purpose is to fund the sale of any solids-not-fat (SNF) portion of industrial milk surplus to domestic requirements. Again, because prices in international markets are lower than those in Canada, export sales require the price difference to be funded from producer sources in order to maintain the integrity of the offers-to-purchase and support price programs. In-quota levies are therefore integrated into the target return on industrial milk. The reason for a characteristic surplus in SNF within the Canadian market is that supply and demand in the industrial milk and cream sector are balanced on the basis of butterfat as a policy objective. With an embargo placed on imports of butter, Canadian butterfat requirements must be met entirely from domestic sources, resulting in a typical SNF surplus. This is portrayed graphically

FIGURE 2: EQUILIBRIA IN THE SUPPLY-MANAGED CANADIAN DAIRY INDUSTRY



in Figure 3, with the difference (Q_{BF} - Q_{SNF}) equivalent to the exportable SNF surplus.

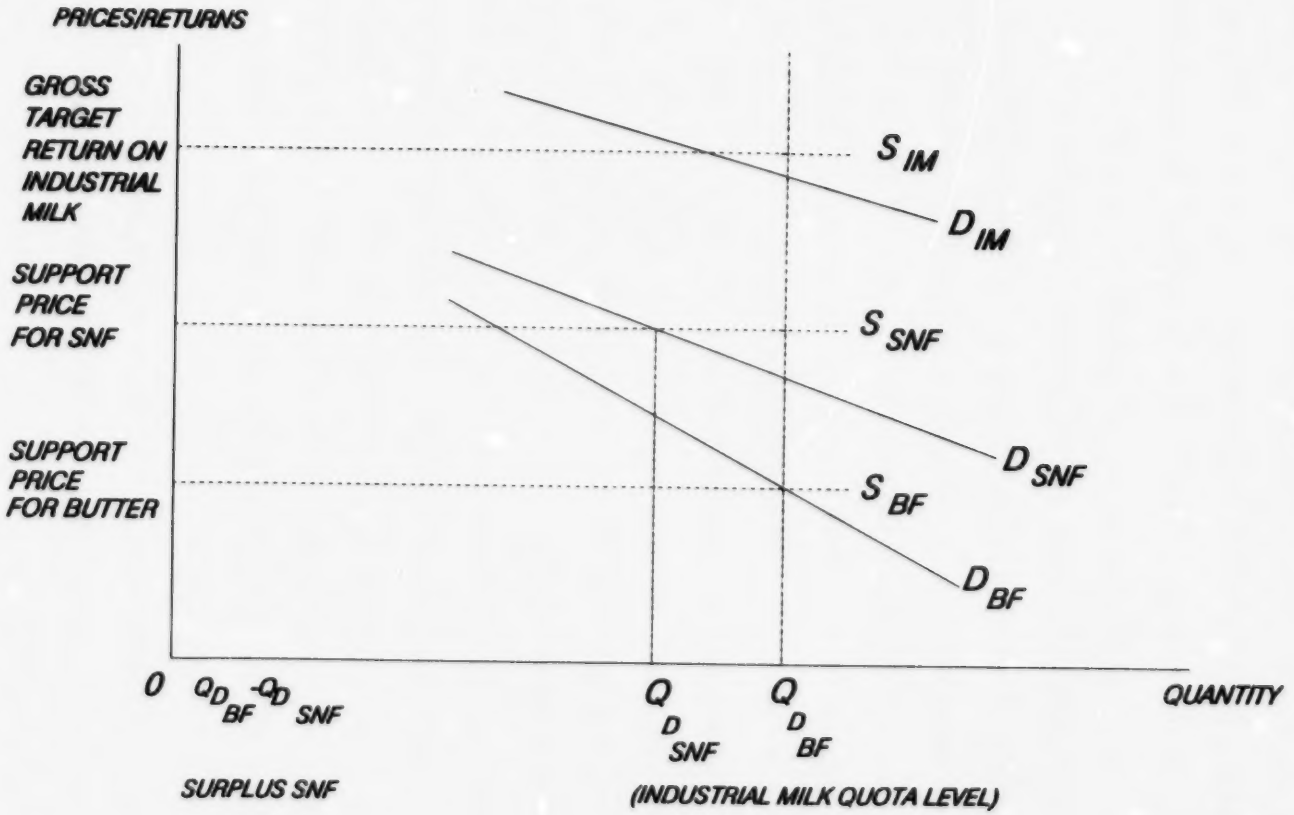
In a technical context, Canadian milk and cream supplies are the product of the stock of dairy cows and average productivity of cows. The latter can be viewed as more of a "longer-term" variable, changing slowly over time as management and technology improve. The former variable may be viewed as a "shorter-term" variable with rapid responses to changing market conditions made possible by virtue of Canada's consistent position of surplus cows and heifers available for export or herd expansion, and by virtue of a beef market for absorbing any surplus stock. Factors influencing dairy cow stocks may include prices of milk relative to those for beef, market values of milk quota and utilization rates of milk quotas.

Quota values emanate from economic rents - actual or perceived - earned or anticipated to be earned from participation in an industry viewed as profitable and secure relative to alternative farm enterprise lines, but one in which supply possibilities are limited. The rental benefits can be expected to be capitalized internally by producers and to be attached to the resource with the lowest elasticity of supply with respect to price, namely quota.

Milk Allocation and Processing Sector

All demands for milk and cream at the farm level are derived

FIGURE 3: SUPPLY AND DEMAND BY COMPONENT IN THE CANADIAN INDUSTRIAL MILK MARKET



from consumer demands for the final products, with intermediation provided by the dairy processing sector. Processing plants receive what is essentially a homogeneous raw product from farms whether fluid or industrial milk shipments are involved. Allocation of this homogeneous product among competing end uses then becomes a function of relative marketing margins. Marketing margins in turn depend on final product demand characteristics, final product technical characteristics (e.g. perishability vs. preservability), processing costs, and, in the case of the dairy industry, price discriminatory powers of provincial marketing boards or commissions responsible for setting prices on behalf of milk producers. In all provinces, some degree of differential pricing of milk destined for different end uses is practised by the monopoly milk board or commission.

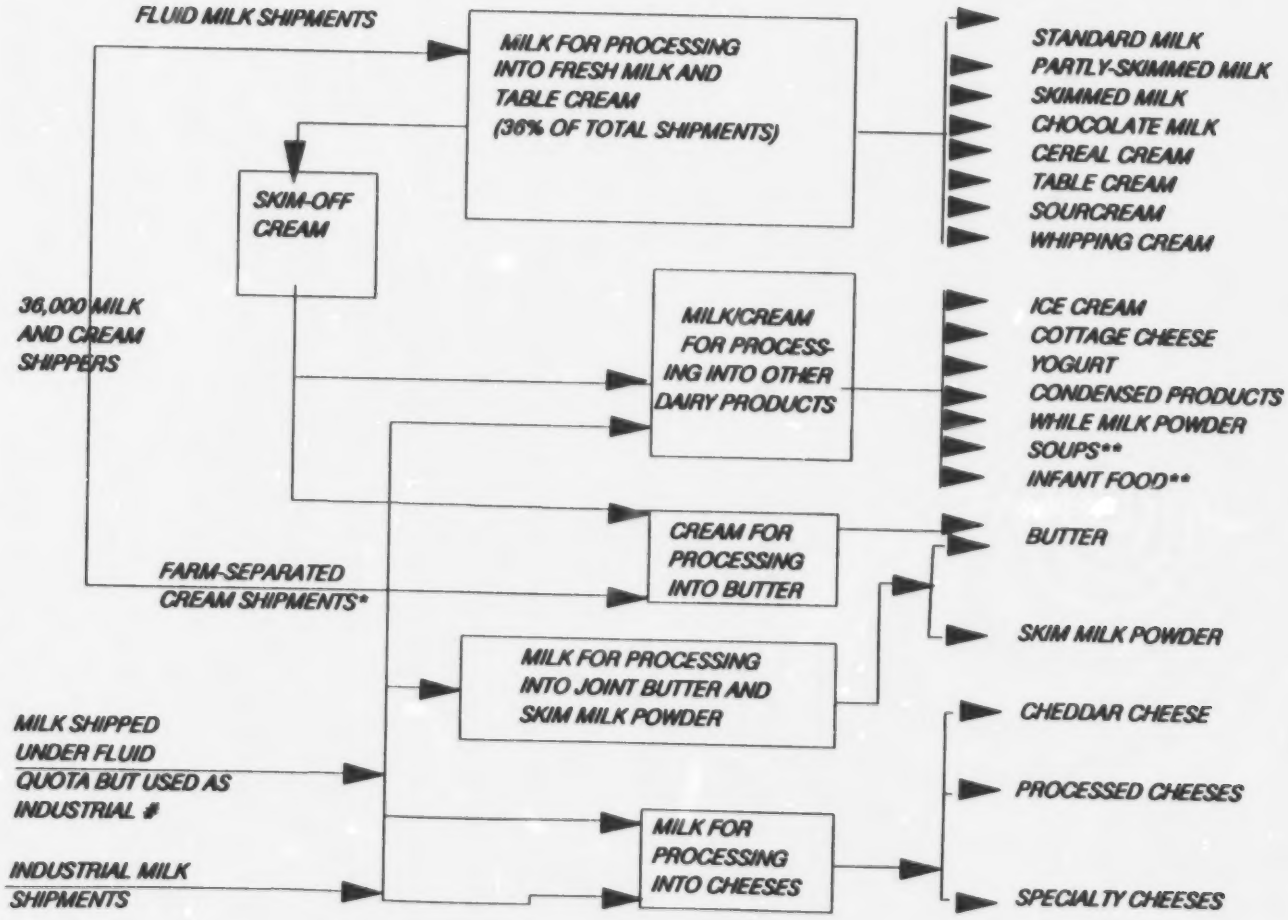
The principal final product lines in processing plants are table creams and fresh milk - from fluid milk shipments; and cheeses, joint butter and skim milk powder,and other products (such as ice cream, yogurt, cottage cheese, condensed products, whole milk powder, etc.) - from industrial milk and cream shipments. In order to encourage milk producers to ship (fluid or industrial) milk with a higher butterfat content, premiums are paid for butterfat over the 3.6 kg./100 litres level and penalties exacted for lesser levels. Most milk is shipped with a minimum content of 3.6 kg./100 litres. This is more than is required for fresh "whole" (standard) milk (3.5% butterfat), partly-skimmed milk (2% butterfat) or skimmed milk (0.2% butterfat). The reduction of fat

content by processing plants provides the raw material for fresh table creams, plus a residual amount referred to as "skim-off" cream. Skim-off cream is used in the manufacture of ice cream or butter. All milk shipped under the purview of fluid milk quotas is not necessarily required to meet fresh table uses. Any surplus to these uses is transferred to the industrial milk sector to be joined by the milk and cream shipped under industrial quotas. This allocation and transformation process at the dairy processing level is illustrated schematically in **Figure 4.**

Stock-Holding Sector

Cheeses, butter, powdered products and condensed dairy products may be held in stock because of their preservable nature. Ice cream may be held in stock for a limited period (several months). All other products must be consumed fresh because of their perishable nature. There are two technical reasons to hold stocks of dairy products in Canada - one concerns seasonality of milk production, the other, aging of cheeses. The seasonality factor on the production side follows the natural breeding cycle which leads to calving in the spring and major milk output during the summer, coincident with the flush of pasture growth. Although not nearly so prominent a phenomenon in the 1980's as previously, there is still a pronounced peaking of milk and cream shipments in the May - June period of the year, and an

FIGURE 4: ALLOCATION AND TRANSFORMATION OF MILK/ CREAM AT THE PROCESSING LEVEL



* 2.3% OF TOTAL SHIPMENTS # 61.7% OF TOTAL SHIPMENTS

** PART DAIRY PRODUCTS ONLY

off-setting trough during the November - February period (Caine and Stonehouse, 1983). Consumption of milk and dairy products, by contrast, displays little seasonality. The resulting supply-demand imbalances require the processing of "surplus" milk in the spring into preservable products for use during the fall-winter "deficit" milk period. Most of the surplus milk is processed into the joint products, butter and skim milk powder, with some being allocated to evaporated milk and whole milk powder.

There are two sets of stock holders of dairy products in Canada. The commercial set is comprised of dairy processing plants holding stocks of preservable products according to transactions demand and speculative demand behaviour. In particular, cheddar cheeses are held in stock to "age" the product, thereby enhancing their value. The other stock holder is the federal government, which, through the Canadian Dairy Commission (CDC), absorbs any temporary surpluses of butter and skim milk powder in fulfillment of the offer-to-purchase provisions. Necessarily, commercial dairy processing plants were wont to treat joint butter-powder stocks as a government responsibility, and therefore as a residual usage of milk and cream, as long as the CDC absorbed the costs of storage. In 1986, legislative changes made the commercial sector responsible for storage costs of CDC-purchased butter stocks. Similar legislation covering CDC-purchased skim milk powder stocks was introduced in 1989. This may have influenced the residual status of butter stocks since 1986.

Domestic Demand Sector

Although separate demand estimations could be made for the many differentiated dairy products enumerated in Figure 4, it was decided to estimate demands only for a) standard milk, b) low-fat milks, c) table creams, d) butter, e) skim milk powder, f) cheeses, and g) all other dairy products. The rationale for sub-dividing the estimation of demand for fresh fluid products into two different types of milks and table creams is to permit a superior estimation of the volume of skim-off cream flowing from the fluid processing to the industrial processing sector. The rationale for sub-grouping demands for processed products into butter (and its joint product skim milk powder), cheeses, and other products is the degree to which butter/powder and cheeses absorb available industrial milk and cream supplies, including skim-off cream. Butter/powder production accounts for about 45 percent of industrial raw material supplies, and cheeses for about 50 percent. The plethora of other processed products absorbs a relatively unimportant 5 percent.

Factors influencing demand at the per-capita level are taken to be own price, price of a competing and/or complementary product, disposable income, and a trend variable as a proxy for changes in consumer tastes and preferences and eating habits (e.g. percentage of meals eaten outside the home). Per-capita demand estimates are then translated to aggregate demand levels by multiplying by Canadian population data.

Prices Sector

The three critical levels for establishing prices in the dairy industry are at the farm gate, at wholesale and at retail. Farm-gate prices serve to clear markets between raw material supplies from farms and the derived demands of dairy processing plants. Wholesale prices operate to clear markets between processing plants supplying and retail outlets demanding dairy products. Retail prices establish market clearance between retail outlet suppliers and consumer demanders of various dairy products. Price-estimating equations at all three levels are included in the model of the dairy industry.

Federal governmental intervention is strongly felt in dairy industry price-setting, directly at the wholesale level and indirectly at the farm-gate level, through the CDC offers-to-purchase program and support price schemes for butter/skim milk powder. Provincial milk marketing boards or commissions are empowered to set minimum farm-gate prices for both fluid and industrial raw product, according to final end use. Federal government key product support prices and target prices for industrial/cream shippers are based on actual costs of the most efficient 70 percent of producers collected by annual surveys. For example, for 1987, the survey costs resulted in weightings of 47 percent for cash costs of production, 23 percent for returns to capital, and 30 percent for returns to labour (Table 1).

TABLE 1: FEDERAL GOVERNMENT TARGET SUPPORT PRICE FOR INDUSTRIAL MILK[a]

Cost Item	Weighting Factors	Example costs
Cash Costs	(%)	$/hl
Purchased feed	12	
Artificial insemination	1	
Veterinary, haulage and board fees	10	
Machinery, equipment repairs	4	
Fuel and oil	2	
Custom work	1	
Fertilizer and herbicides	3	
Seeds and plants	1	
Other (miscellaneous)	1	
Land and building repairs	2	
Property taxes and insurance	3	
Hydro and telephone	2	
Hired labour	5	
Total Cash Costs	47	21.83
Capital Costs		
Interest	5	
Building depreciation	2	
Machinery and equipment depreciation	6	
Cow depreciation	1	
Return on equity	9	
Total Capital Costs	23	10.88
Producer Labour Costs		
Direct labour	29	
Return to management	1	
Total Producer Labour Costs	30	14.21
Amount to cover butter carrying charges		0.14
Target Price		47.06

[a] Source: CDC Annual Report for 1987-88
[b] Industrial milk target price from February 1, 1988

Provincially-set fluid milk and industrial milk (differentiated by end-use class) farm-gate prices are set according to various formulae accounting for changes in economic circumstances for dairying, and with reference to the federally-set target support price. Governmental interventions are therefore much more important than market supply-demand forces in the setting of prices at the farm-gate, and at wholesale levels for butter-skim powder. Governments and their price-setting agencies do not, however, operate in a politico-economic vacuum, but rather are sensitive to basic supply-demand changes through feedback effects from such factors as changes in stock levels, net exports and producer quota values.

Price setting at retail and at the wholesale level for all but butter/skim powder is taken for modelling purposes to be a function of market forces operating on more or less a purely competitive basis within the context of a closed domestic market.

Net Trade Sector

Little is conducted by way of commercial international trade in dairy products by Canada. Imports of all dairy products are strictly controlled in order to support the supply-managed, price-regulated industry within Canada. Embargoes exists on imports of fluid milks, table creams, butter, skim milk powder, and products containing these dairy inputs. Specialty cheeses are permitted under licence, and subject to an aggregate annual quota across all varieties of cheeses, because Canadian plants produce only about 70 of the more-than-200 varieties sold at retail. Production runs for

the majority of specialty cheeses are considered too small to justify on economic grounds at Canadian plants.

Exports of cheddar cheese comprise the principal commercial foreign outlet for Canadian dairy products, with destinations in the European Community and the United States of America. Both importing regions regulate Canadian sales through their own import quota schemes. Most other exports represent sales of Canadian dairy products surplus to domestic and commercial export requirements, mostly in the form of whole milk powder and condensed products, some as skim milk powder. As such, these surplus products must generally be subsidized in order to bring sale prices in line with much lower levels in export markets, chiefly in the Middle East and Latin America.

Reflecting the relatively small importance of trade in dairy products, equations are included in the model for net trade in (all) cheeses and in butter, and for exports of skim milk powder, and other dairy products.

Government Policy Block

To recapitulate, the principal policy instruments used to regulate the Canadian dairy industry are quotas and over-quota levies to control supplies of raw products; offers to purchase and support prices for key processed dairy products; target support prices, including direct subsidies for industrial milk and cream; returns formulae (at the provincial levels) for fluid milk, industrial milk and cream shipments; within-quota and special

export quota levies on producer returns to fund exports of surplus products; and tariffs, embargoes and import quotas on dairy products (for details, see Stonehouse, 1987). Shipment quotas are set by provincial authorities for fluid milk, and by joint federal-provincial authority for industrial milk and cream, in accordance with anticipated demands in domestic and commercial export markets at pre-specified target and support prices. Setting of quota levels would then be based on recent sales experiences, and on stocks fluctuations.

Support and target prices for the industrial sector and fluid sector prices at the farm-gate level are a function of dairy producer cost surveys, weighted through formula prescriptions. In particular for the industrial sector, producer costs form the basis of target support price changes in accordance with a re-formulated approach introduced on February 1, 1988. The target support price is met in part from direct producer subsidies, whose unit levels have not changed since 1975, and in part from the support prices for butter and skim powder expressed in milk equivalent terms with the use of a dairy processing plant marketing margin whose size is established through "rules of thumb" (Stonehouse, 1987).

The target support price also embodies the "within-quota" levy, an amount set equal to the differential between Canadian support prices and international prices for the skim milk powder fraction of a litre of industrial milk, multiplied by the ratio of expected aggregate surpluses of skim milk powder production in Canada to the total shipments of industrial milk under quota (i.e.

by expectation, industrial milk less farm-separated cream quota issued). Thus all shippers of industrial milk are deemed to be potential contributors to Canada's skim milk powder surplus, and are therefore called upon to share in the subsidizing of its disposal.

For those provinces wishing to participate in the special exports program, a special exports levy is exacted to cover any cost differential for disposing of commercial exports (mostly in the form of whole milk powder or condensed milk products) in exports markets with prices considerably lower than those in Canada. Producers in provinces exceeding their aggregate provincial quota for domestic and commercial export requirements, plus any special export involvement, are liable for an over-quota levy. In theory, such a levy is payable by any individual producer exceeding his allotted quota on industrial milk or cream. However, the levy can be (and frequently has been in the past) rescinded if either the province has other shippers not meeting their quota and has an aggregate shipment level not exceeding its (provincial) quota, or there are other provinces in a deficit shipment position high enough to compensate for the overall surplus positions of provinces exceeding their quotas. The over-quota levy must be sufficient to cover the cost of disposing of both butterfat and solids-not-fat fractions of industrial milk surplus to domestic and commercial export requirements. It is therefore set equal to the price differentials between Canadian support and international price levels for the joint products butter and skim milk powder.

In an attempt to capture the important elements of government dairy policies, there are equations in the model for estimating quotas, support prices, gross and net target returns on industrial milk, average farm-gate prices for fluid milk, formulae for adjusting target returns, and within-quota and over-quota levies. Additional equations are included for estimating supplementary payments to milk shippers, and industrial milk and cream requirements.

THE EMPIRICAL MODEL

Consolidation of the original model's milk allocation and processing, domestic demand, and price equation sections led to a reduction in the number of equations, but this was more than offset by increases in the number of equations in the government policy and farm supply blocks. These adjustments resulted in a net increase of two equations overall.

Of the 64 equations in the revised empirical model, 33 are stochastic equations used to estimate the more important supplies of raw and processed products, stock-holding behaviour, net international trade, domestic disappearance, wholesale and retail price-setting, and dairy policy instrument setting. The remaining 31 equations are comprised of identities or accounting equations.

The nine equations in the farm supply block identify separately the farm shipments of fluid milk, industrial milk and farm-separated cream, and aggregate milk and cream shipments; and farm inventories of dairy cows and dairy heifers, the principal

technical influences on shipments. One new stochastic equation has been added for estimating the value of quota controlling shipments of industrial milk in Ontario.

Allocation of industrial milk and cream at the processing plant level is subsumed by a set of 16 equations for estimating production, stocks, net trade and aggregate domestic disappearance for four principal processed product groups - creamery butter, skim milk powder, cheeses, and other processed dairy products. A net reduction of two equations in this block was accomplished by combining separate equations for evaporated milk and ice cream in the original model into a single set of equations for "other processed dairy products". The other products category includes all condensed products, whole milk powder and fresh products such as yogurt, ice cream and cottage cheese. Three equations for calculating aggregate domestic disappearance of table milk and creams complete the allocation of farm shipments of raw product among processed products.

The equations for estimating per-capita domestic disappearance included one each for the four principal processed product groups, plus one each for domestic disappearance of standard fluid and low-fat fluid milk, and creams. Again, a net reduction of one equation in the domestic disappearance block was made possible by conjoining the equations for evaporated milk and ice cream in the original model into a single equation for other processed dairy products.

A set of 18 equations in the policy block permits estimation of support prices of key processed products, gross and net target

returns for industrial milk, government subsidy payments, fluid milk prices to producers, fluid and industrial shipment quotas, domestic requirements for industrial milk, producer levy rates, and processing plant marketing margins. New equations in the revised model include identities for industrial milk/cream quota issued in Quebec, Ontario, the Atlantic Provinces, and Canada overall; an identity for total industrial milk/cream requirements using the CDC dairy stocks approach; and two stochastic equations for estimating within-quota and over-quota levies on producer returns. Two equations for estimating dairy cash costs of production except for 16-percent dairy ration, and target returns on industrial milk in the original model were deemed superfluous and deleted.

Wholesale and retail prices of milk and dairy products are estimated through a set of 9 equations, a reduction of two equations from the total in the original model (through consolidation of the equations for other processed dairy products). Finally, there is an equation for estimating total farm cash receipts from dairying, and one for estimating the index price of dairy concentrate feed.

In addition to the structural alterations to the model noted above, the specification of a number of equations was changed. In particular, the equations for SMCC,SMKC,SPC,IDC and IDH in the farm supply bock, the PCCB,PCPM and PCFC equations in the domestic disappearance block, the equations for XAPM, XPFM, and XGTM in the dairy policy block, and the price-block equations RPCB,RPDP,RPFM, RPPM and WPCH were re-specified, most with greater simplicity, as

well as improved statistical and forecasting performance, in mind; **(for explanation of mnemonics, see Specification of Equations, below and Appendix A).**

The data series for all variables were re-structured on a dairy quarter, as opposed to a calendar quarter basis. Thus, quarter 1 extends from February 1 to April 30, quarter 2 from May 1 to July 31, and so on, within the data banks of the TROLL computer software system used to operate the model; because the dairy year in Canada begins on August 1, model results for the period August 1 to October 31 are interpreted as those for the first dairy quarter, and so on.

SPECIFICATION OF EQUATIONS

Farm Supply Block - the nine equations are used to estimate:

Total milk and cream shipments from farms:
SMKC3: SMFP3 + SMMC3

Shipments of industrial milk and cream:
SMMC3: JS1, JS2, JS3, JS4, XMSQ3

Shipments of fluid milk:
SMFP3: DMS3, $DMS3_{t-1}$, DLM3, $DLM3_{t-1}$, DCRM3, $DCRM3_{t-1}$, D1975

Inventory of dairy cows:
IDC3S: JS2, JS4, SMKC3, $SMKC3_{t-1}$, $FPDR2_{t-1}$, $RPRIME3_{t-1}$, $PBW2_{t-1}$, $IDH3S_{t-2}$, $ID3S_{t-2}$, TIME

Inventory of dairy heifers:
IDH3S: JS2, JS4, $IDC3S_{t-4}$, $IDC3S_{t-8}$, $PHF2_{t-1}$, $FPDR2_{t-1}$

Milk Shipments per cow:
SPC3: SMKC3 * 1000/(IDC3S + $IDC3S_{t-1}$)/2

Shipments of farm-separated cream:
SFSC3: JS1, JS2, JS3, TIME, $XWPCB3_{t-4}$, $XAPM3_{t-4}$, $XSUM3_{t-4}$, $XWPPM3_{t-4}$

Supply of "skim-off cream" from fluid processing to industrial milk sector:
SSOC3: DCRM3, $DCRM3_{t-1}$, DLM3, $DLM3_{t-1}$, DMS3, $DMS3_{t-1}$

Value of "Used" Market Sharing Quota:
USEDONT4: JS1, JS2, JS3, XNTM3/FPDR2, PHG2/FPCO2, RFC3

Dairy Product Processing and Disposition Block

19 equations allocate total milk and cream shipments among alternative uses by estimating:

Production of factory cheese:
QFC3: DFC3 + NFTC3 + CIFC3 - $CIFC3_{t-1}$

Net international trade in factory cheese:
NTFC3: EXQFC3 + EXNQFC3 - IMFC3

Closing inventories of factory cheese:
CIFC3: JS1,JS2,JS3,DFC3,TIME, QFC3, $CIFC3_{t-1}$

Aggregate domestic disappearance of factory cheese:
DFC3: PCFC3 * POPN3

Production of other dairy products:
QODP3: DODP3 + EXODP3 + IODP3 - $IODP3_{t-1}$

Exports of other dairy products:
EXODP3: 0.222*EXEM3 + 0.0893 EXWMP3

Closing inventories of other dairy products:
IODP3: JS1,JS2,JS3, QODP3, $DODP3_{t-1}$, $IODP3_{t-1}$

Aggregate domestic disappearance of other dairy products:
DODP3: PCODP3*POPN3

Production of creamery butter:
QCB3: (SMMC3 + SSOC3-0.1068*QFC3-QODP3-XMRES3)/0.2273

Closing inventories of creamery butter:
ICB3: QCB3+$ICB3_{t-1}$ -DCB3-NTCB3

Net international trade in creamery butter:
NTCB3: EXCB3-IMCB3

Aggregate domestic disappearance of creamery butter:
DCB3: PCCB3*POPN3

Production of skim milk powder:
QPM3: JS1,JS2,JS3,QCB3,SSOC3,SFSC3,QODP3,SMMC3

Exports of skim milk powder:
EXSMP3: JS1,JS2,JS3,JS4,QPM3, $IPM3_{t-1}$, XWPPM3, $EXSMP3_{t-1}$

Closing inventories of skim milk powder:
IPM3: QPM3 + $IPM3_{t-1}$ -DPM3-EXSMP3

Aggregate domestic disappearance of skim milk powder:
DPM3: PCPM3*POPN3

Aggregate domestic disappearance of standard milk:
DMS3: PCMS3*POPN3

Aggregate domestic disappearance of low-fat milk:
DLM3: PCLM3*POPN3

Aggregate domestic disappearance of cream:
DCRM3: PCCRM3*POPN3

Per-capita Domestic Disappearance Block - these seven equations estimate:

Per-capita disappearance of standard milk:
PCMS3: JS1,JS2,JS3,RPWFM3,RPOJ3,TIME,PCDY3

Per-capita disappearance of low-fat milk:
PCLM3: JS2,JS3,RPLFM3, CPI3,PCDY3,TIME

Per-capita disappearance of cream:
PCCRM3: JS1,JS2,JS3,PCDY3,RPFO3,RPFM3.

Per-capita disappearance of creamery butter:
PCCB3: JS1,JS2,JS3,RPCB3,CPI3,RPMG3,PCDY3,TIME,$PCCB3_{t-1}$

Per-capita disappearance of factory cheese:
PCFC3: RPCH3,CPI3,RPBF3,PCDY3,TIME

Per-capita disappearance of skim milk powder:
PCPM3: JS1,JS2,JS3,PCDY3,CPI3,RPPM3,RPFM3

Per-capita disappearance of other dairy products:
PCODP3: JS1,JS2,JS3,XWPCB3,XWPPM3,CPI3,TIME

Government Policy Block - the 18-equation set estimates the principal instruments of dairy policy, including:

Gross target return on industrial milk:
XGTM3: IF JS3 EQ 1 THEN XDCCI2 + 10.88*$CPI3_{t-1}$/140.23
+4.21*$WA3_{t-1}$/451.44 + 0.14 - 0.02 * $XGTM3_{t-1}$
ELSE $XGTM3_{t-1}$

Net target return on industrial milk:
XNTM3: XGTM3-XIQH3

Net price for industrial milk over quota:
XPMOQ3: XGTM3-XSUM3-XPNM3

Dairy cash cost of production index:
XDCCI2: [0.12*$FPDR2_{t-1}$/240.87+0.15*$FIPSERV3_{t-1}$/129.5+
+0.04*$FIPMAIN3_{t-1}$/123.3+0.02*$FIPPET3_{t-1}$/110+
+0.03*$FIPFERT3_{t-1}$/86.2+0.01*$FIPSEED3_{t-1}$/102.7+
+0.02*$FIPBRPR3_{t-1}$/133.8+
+0.03*$FIPTAX_{t-1}$/134.3+
+0.05*$FIPWAGE3_{t-1}$/132.6]/0.47*21.83

Wholesale - level support price for skim milk powder:

XWPPM3: IF XGTM3 + XAPM3 - $XGTM3_{t-1}$ - $XAPM3_{t-1}$EQ O THEN BXWPPM3 + $XWPPM3_{t-1}$ ELSE BXWPPM3 + $XWPPM3_{t-1}$ + +(XGTM3 + XAPM3 - $XGTM3_{t-1}$ - $XAPM3_{t-1}$)/(2*8.54)

Wholesale - level support price for creamery butter:

XWPCB3: BXWPCB3 + (XGTM3-(XSUM3 + XWPPM3 * 8.54) +XAPM3)/4.365

Assumed dairy processing plant margin:

XAPM3: (IF JS1 + JS3 = EQ 1 THEN XAPM3.0 + XAPM3.1* *$WA3_{t-1}$ ELSE $XAPM3_{t-1}$)

Average price of fluid milk at farm level:

XPFM2: WA3,$WA3_{t-1}$,XDCCI2,$XDCC12_{t-1}$,$XPFM2_{t-1}$

Total fluid and industrial milk quota issued:

XQM3: XEDRM3 + $SMFP3_{t-1}$ + $SMFP3_{t-2}$ + $SMFP3_{t-3}$ + $SMFP3_{t-4}$

Industrial milk quota issued in Ontario:

XMSQ21: 0.311 * XMSQ3

Industrial milk quota issued in Quebec:

XMSQ22: 0.477 * XMSQ3

Industrial milk quota issued in the Atlantic Provinces:

XMSQ27: 0.045 * XMSQ3

Industrial milk and cream requirements:

XMREQ3: BXMREQ3+0.2273*DCB3+0.1068*DFC3+XMRES3+DODP3+ +0.1068*(EXQFC3-IMFC3+ 0.7*NTPC3)-SSOC3- -0.2273*IMCB3

Industrial milk and cream requirements, using dairy product inventories:

XEDRM3: [IF JS1 + JS3 EQ 1 THEN (16-SUM(I=-4 TO - 1: ICB(I)/4)) * 0.2273 + XEDRM3.1 * SUM (I=-3 TO 0: XMREQ3(I)) ELSE $XEDRM3_{t-1}$]

Industrial milk and cream quota issued in Canada:

XMSQ3: XEDRM3 + XSPX3 + XSLV3

Supplementary payments to milk shippers:

XCRDY3: (XCRDY 3.0 + XCRDY3.1 + XCRDY3.2 * JS1+
+ XCRDY3.3*JS2 + XCRDY3.4 * JS3)
*XSUM3*SMMC3-XCRDY3.4*JS3
*[IF SUM (I=-4 TO -1: SMMC3(I))
-(XEDRM3$_{t-1}$ + XSSPX3$_{t-1}$ + XSPX3$_{t-1}$)GE 0 THEN
SUM(I=-4 TO -1: SMMC3(I)) - (XEDRM3$_{t-1}$
+XSSPX3$_{t-1}$ + XSPX3$_{t-1}$) * XSUM3 ELSE 0]

In-quota holdback levy on industrial milk:

XIQH3: BXIQH3 + XIQH3.1 *JS3
*((IPM3$_{t-1}$-20 + SUM(I=-4 TO -1: EXSMP3(I))
* (XWPPM3-EXPPM3$_{t-1}$) + XSPX3* XPNM3 - FLUIDLV3
* SUM (I=-4 TO -1: SMFP3(I))
-IMCB3*(XWPCB3 - UVLBTNZ/1000))/(XEDRM3 + XSPX3)
+ JS1*XIQH3$_{t-1}$ + JS2*XIQH3$_{t-1}$+JS4*XIQH3$_{t-1}$

Over-quota levy on industrial milk:

XPNM3 = JS3(BXPNM3 + XPNM3.1 (8.54(XWPPM3-
EXPPM3)+4.41(XWPCB3-UVLBTNZ)
+(JS4 +JS1+JS2)(XPNM3$_{t-1}$))

<u>Wholesale and Retail Price Block</u> - wholesale and retail prices for milk and key dairy products are estimated by the following 9 equations:

Wholesale price of Cheddar cheese:

WPCH3: XWPCB3; XWPPM3; FMCTO3

Consumer price index for Cheddar cheese:

RPCH3/RPCH3$_{t-1}$: WPCH3/WPCH3$_{t-1}$,WPCH3$_{t-1}$/WPCH3$_{t-2}$,
FMCTO3/FMCTO3$_{t-1}$

Wholesale price index of evaporated milk:

WPEM3/WPEM3$_{t-1}$: XWPCB3,XWPPM3,XWPCB3$_{t-1}$,XWPPM3$_{t-1}$

Wholesale price index of ice cream:

WPIC3/WPIC3$_{t-1}$: XWPCB3,XWPPM3,XWPCB3$_{t-1}$,XWPPM3$_{t-1}$

Consumer price index for fluid milk:

RPFM3/RPFM3$_{t-1}$: RPWFM3,RPLFM3,RPWFM3$_{t-1}$,RPLFM3$_{t-1}$

Consumer price index for whole (standard) fluid milk:

RPWFM3: XPFM2,FMCTO3,RPWFM3$_{t-1}$

Consumer price index for low-fat fluid milk:

RPLFM3: XPFM2,XPFM2$_{t-1}$,FMCTO3,RPLFM3$_{t-1}$

Consumer price index for creamery butter:

RPCB3/RPCB3$_{t-1}$: XWPCB3/XWPCB3$_{t-1}$,XWPCB3$_{t-1}$/XWPCB3$_{t-2}$,
FMCTO3/FMCTO3$_{t-1}$

Consumer price index for skim milk powder:

RPPM3: $XCSUP3_{t-1}$, FMCT03, XWPPM3, XCSUP3, $XWPPM3_{t-1}$

Farm Cash Receipts from Dairying are estimated from the following accounting equation:

CRDY3: BCRDY3+CRDY3.0+CRDY3.1*SMFP3*XPFM2
+(CRDY3.2+CRDY3.3*JS1+CRDY3.4*JS2+CRDY3.5*JS3)
*(XNTM3-XSUM3)*SMMC3+CRDY3.6*JS3*
*(IF SUM(I=-4 TO -1:SMMC3(I))-$XEDRM3_{t-1}$+ $XSSPX3_{t-1}$+ $XSPX3_{t-1}$)
GE 0 THEN (SUM (I=-4 TO-1:SMMC3(I))-($XEDRM3_{t-1}$+
+$XSPX3_{t-1}$+$XSPX3_{t-1}$)))*($XPNM3_{t-1}$-$XIQH3_{t-1}$)ELSE 0)

Factory Price Index for (16% CP) Dairy Ration is estimated from the following stochastic equation:

FPDR2: JS1, JS2, JS3, FPCO2, PSM2, $FPDR2_{t-1}$

Definition of the Variables

Endogenous and Definition Variables:

CIFC3	Closing Inventory of Cheese, Canada (mil. kg)
CRDY3	Farm Cash Receipts for Dairy, Canada ($mil.)
DCB3	Disappearance of Creamery Butter, Canada (mil. kg)
DCRM3	Disappearance of All Creams - Milk Equiv., Canada (mil. l)
DFC3	Disappearance of Cheese, Canada (mil. kg)
DLM3	Disappearance of Low Fat Milk, Canada (mil. l)
DMS3	Disappearance of Standard Milk, Canada (mil. l)
DODP3	Disappearance of Other Dairy Products-Milk Equiv., Canada (mil. l)
DPM3	Disappearance of Skim Milk Powder, Canada (mil. kg)
EXODP3	Exports of Other Dairy Product Exports, Canada (mil. l)
EXSMP3	Exports of Skim Milk Powder (Stat. Can. Basis), Canada (mil. kg)
FPDR2	Price Index for Dairy Ration, Eastern Canada (1971=100)
ICB3	Closing Stocks of Butter, Canada, (mil. kg)
IDC3S	Closing Inventory of Dairy Cows, Canada ('000)
IDH3S	Closing Inventory of Dairy Heifers, Canada ('000)
IODP3	Closing Stocks of Other Dairy Products, Canada (mil. kg)
IPM3	Closing Stocks of Powdered Milk, Canada, (mil. kg)
NTCB3	Net Trade in Butter, Canada (mil. kg)
NTFC3	Net Trade in Cheese, Canada (mil. kg)
PCCB3	Per-Capita Disappearance of Butter, Canada (kg)
PCCRM3	Per-Capita Disappearance of Creams in Milk Eq, Canada (l)
PCFC3	Per-Capita Disappearance of Cheese, Canada (kg)
PCLM3	Per-Capita Disappearance of Low Fat Fluid Milks, Canada (l)
PCMS3	Per-Capita Disappearance of Standard Fluid Milk, Canada (l)
PCODP3	Per-Capita Disappearance of Other Dairy Products, Canada, (mil. l)
PCPM3	Per-Capita Disappearance of Skim Milk Pouder (kg)
QCB3	Production of Butter, Canada (mil. kg)
QFC3	Production of Cheese, Canada (mil. kg)
QODP3	Production of Other Milk Products (Yogurt, Etc.), Canada (mil. hl)
QPM3	Production of Skim Milk Pouder, Canada (mil. kg)
RPCB3	CPI for Butter, Canada (1981=100)
RPCH3	CPI for Cheddar Cheese, Canada, (1981=100)
RPFM3	CPI for Fluid Milk, Canada (1981=100)
RPLFM3	CPI for Low-Fat Milk (2%), Canada (1981=100)
RPPM3	CPI for Skim Milk Pouder, Canada (1981=100)
RPWFM3	CPI for Whole (Standard) Fluid Milk, Canada (1981=100)
SFSC3	Shipments of Farm-Separated Cream, Canada (mil. hl)
SMFP3	Supply of Milk for Fluid Purposes, Canada (mil. hl)
SMKC3	Shipments of Milk and Cream Off Farms, Canada (mil. hl)
SMMC3	Shipments of Industrial Milk, Canada (mil. hl)
SPC3	Milk Shipments per Cow, Canada (hl/cow)
SSOC3	Supply of Skim-Off Cream from Fluid Milk Processing, Canada (mil. hl)
USEDONT4	Value of "Used" Market Sharing Quota for Industrial milk, Ontario ($/l)
WPCH3	Wholesale Price of Cheddar Cheese (Belleville), Canada ($/kg)
WPEM3	Wholesale Product Price Index for Evaporated Milk, Canada (1981=100)
WPIC3	Wholesale Product Price Index for Ice Cream, Canada (1981=100)
XAPM3	Assumed Dairy Processing Plant Margins, Canada ($/hl)
XCRDY3	Supplementary payments to Dairy Producers, Canada ($mil.)
XDCC12	Dairy Cash Cost Index, Eastern Canada (1971=100)
XEDRM3	Estimated Domestic Industrial Milk Requirements, Canada (mil. hl)
XGTM3	Gross Target Returns for Industrial Milk Canada ($/hl)
XIQM3	In-Quota Holdback on Industrial Milk, Canada ($/hl)
XMREQ3	Industrial Milk Requirements, Canada (mil. hl)
XMSQ21	Industrial Milk Quota, Ontario (mil.kg. BF)
XMSQ22	Industrial Milk Quota, Quebec (mil.kg. BF)
XMSQ27	Industrial Milk Quota, Atlantic Provinces (mil.kg. BF)
XMSQ3	Industrial Milk Quota, Canada (mil. l)
XNTM3	Net Target Return for Industrial Milk, Canada ($/hl)
XPFM2	Average Price of Fluid Milk, Ontario and Quebec, ($/l)
XPMOQ3	Net Price for Over-Quota Milk, Canada ($/hl)
XPNM3	Over-quota penalty on industrial milk, Canada ($/hl)
XQM3	Total Fluid and Industrial Milk Quota, Canada (mil.hl)
XWPCB3	Wholesale Support Price of Butter, Canada ($/kg)
XWPPM3	Wholesale Support Price of Skim Milk Powder, Canada ($/kg)

EXOGENOUS VARIABLES:

CPI3	CPI for All Items, Canada (1981=100)
D1975	Dummy Variable for Change in Dairy Policy in 1975
EXCB3	Exports of Butter, Canada (mil. kg)
EXEM3	Exports of Evaporated Milk, Canada (mil. l)
EXNQFC3	Exports of Non-Quota Cheese, Canada (mil. kg)
EXPPM3	Unit Export Price of Powdered Milk, Canada ($/kg)
EXQFC3	Exports of Quota Cheese, Canada (mil. kg)
EXWMP3	Exports of Whole Milk Powder, Canada (mil. l)
FIPBRPR3	Farm Input Price Index (FIPI) for Building Repair, Canada (1981=100)
FIPFERT3	FIPI for Fertilizer, Canada (1981=100)
FIPI3	FIPI for Total Inputs, Canada (1981=100)
FIPMAIN3	FIPI for Machinery and Motor Vehicle Maintenance, Canada (1981=100)
FIPPET3	FIPI for Petroleum Products, Canada (1981=100)
FIPSEED3	FIPI for Seed, Canada (1981=100)
FIPSERV3	FIPI for Supplies and Services, Canada (1981=100)
FIPTAX3	FIPI for Property Taxes, Canada (1981=100)
FIPWAGE3	FIPI for Hired Farm Labour, Canada (1981=100)
FLUIDLV3	Fluid Levies on Skim-off Cream Transferred to Industrial Sector, Canada ($/hl)
FMCTO3	Food Marketing Cost Index, Total, Canada (1981=100)
FPCO2	Corn Price, Basis In-Elevator, Chatham ($/tonne)
IMCB3	Import of Butter, Canada (mil. kg)
IMFC3	Import of Factory Cheese, Canada (mil. kg)
JS1	Seasonal Dummy, First Quarter
JS2	Seasonal Dummy, Second Quarter
JS3	Seasonal Dummy, Third Quarter
JS4	Seasonal Dummy, Fourth Quarter
NTPC3	Net Trade in Processed Cheese, Canada (mil.kg)
PBW2	Price of Slaughter Cows (D1,2), Toronto ($/cwt)
PCDY3	Per-Capita Disposable Income, Canada ($)
PHF2	Price of Slaughter Heiffers (A1,2), Toronto ($/cwt)
PHG2	Price of Index 100 Hogs, Toronto ($/cwt)
POPN3	Population of Canada (mil.)
PSM2	Soybean Meal Price of 44% Protein, Toronto ($/tonne)
RFC3	Interest Rate on 90-day Finance Company Paper, Canada
RPEN3	Consumer Price Index (CPI) for Energy, Canada (1981=100)
RPFO3	CPI for Fats and Oils, Canada (1981=100)
RPMG3	CPI for Margarine, Canada (1981=100)
RPMT3	CPI for Meat, Canada (1981=100)
RPOJ3	CPI for Orange Juice (1981-100)
RPRIME3	Chartered Banks Prime Business Loan Rate, Canada
TIME	Linear Trend Variable
UVLBTNZ	Unit Export Price of Butter, New Zealand (Can $/tonne)
WA3	Average Weekly Earnings for All Employees (Including Overtime), ALL Survey Units, Industrial Aggregate, Canada ($/Employee)
XCSUP3	Consumer Subsidy on Skim Milk Powder, Canada ($/kg)
XMRES3	Residual from Industrial Milk Supply and Utilization, Canada (mil.hl)
XSLV3	Flexibility Sleeve, on Industrial Milk and Cream Shipments, Canada (mil.hl)
XSPX3	Special Export Quota for Industrial Milk, Canada (mil. hl)
XSSPX3	Special Export Quota Eligible for Subsidy (mil. hl)
XSUB3	Direct Producer Subsidy on Industrial Milk, Canada ($/hl)
YEARQ	Quarterly Trend Variable Where, for Example, 198001=19801

DISCUSSION OF EQUATION SPECIFICATIONS

Farm Supply Block

Total shipments of milk and cream (SMKC3) under Canada's supply management system are a function of total quotas allocated for both fluid milk and industrial milk and cream. The effectiveness of quotas in limiting milk supplies is greatly enhanced by an over-quota levy, which penalizes those farmers exceeding their allotted quotas by reducing unit returns. The over-quota levy is a policy instrument set each year equal to the calculated amount required to dispose of surplus milk transformed into joint butter and skim milk powder in world markets at prices much lower than internal Canadian support levels. Theoretically, total shipments are a function of milk yields per cow (SPC3) and inventories of cows (IDC3S). Although, subsumed by institutional arrangements, these technical equations are retained in the revised model as the basis for estimating milk shipments as a function of technical factors and market forces.

Shipments of industrial milk and cream (SMMC3) are determined institutionally by current industrial quota issued (XMSQ3). Also, seasonality factors (JS_i) though much less important now than formerly, still cause a surge in supplies in spring and a dearth in fall and winter as a result of the natural calving schedule (Caine and Stonehouse, 1983). The industrial sector absorbs any seasonal fluctuations in supplies, being the residual after fluid milk requirements are met. Shipments of farm-separated cream (SFSC3, a part of SMMC3), are a function of net returns, seasonality factors,

and a long-term, shrinking-industry trend, rather than of allotted quotas. Shrinkage of the farm-separated cream industry is a function of factors such as increased specialization, changing farm structure (toward larger-scale dairy operations), and institutional arrangements that tend to favour milk-shippers over cream shippers (Stonehouse and Tabi, 1988). Producer net target returns are a composite of direct subsidy payments (XSUM3), butter and skim milk powder support prices (XWPCB3 and XWPPM3), and the marketing margin assumed to be exacted by processing plants (XAPM3). Conversion coefficients for converting milk into butter, skim milk powder, and other products (in, for example, the equations for XWPCB3 and XWPPM3) are those introduced in the 1988-89 dairy year to reflect rising product yields from milk in Canadian dairy processing plants.

Fluid milk shipments can be counted on to exceed issued fluid quota levels because of their high profitability relative to alternative uses of farm resources (Stonehouse et al., forthcoming). Therefore fluid shipments are indirectly a function of quota levels, which in turn are determined by reference to current and recent past domestic disappearance of standard milk, low-fat milk and cream. Fluid shipments surplus to fluid requirements are absorbed as industrial shipments. Surplus cream or "skim-off" cream (SSOC3) from the fluid milk sector is a function of the processing of whole milk into standard milk, low-fat milk and table creams (Stonehouse, 1987).

Values of market sharing quotas covering industrial milk shipments (USEDONT4) typically exhibit seasonal fluctuations, reflecting proximity to dairy year's end (July 31) and therefore how quickly the quota becomes available for use in the year following purchase (i.e. MSQ can be used to cover industrial milk/cream shipments only once in each dairy year: Tabi et al., 1987); hence the inclusion of seasonal dummy variables (JS_i). Any economic rents attributable to quota as a scarce resource would reflect the comparative profitabilities of milk production (XNTM3/FPDR2) and of competing enterprises (e.g. hogs production PHG2/FPC02, or the price of hogs in relation to the price of corn). Interest rates (RFC3) are expected to influence quota values negatively, through the opportunity cost of money and the possible need to borrow to purchase quota.

Dairy Processing Block

For each of the three types of fluid uses of milk (standard and low-fat milks and table creams), allocation of raw material at the processing plant level is according to estimated aggregate domestic disappearance (DMS3, DLM3 and DCRM3). There is no international trade in these products because of institutional controls, and no inventory holding because of the perishable nature of the products.

Allocation of industrial milk and cream among cheese, butter/skim milk powder, and other dairy product uses is a function of derived demand, with allowance made for net international trade

and inventory holding. Processing plants' demands for milk for these different uses is implicitly derived from wholesale product prices received and prices paid by plants for raw material inputs. Explicit relationships of this kind are not specified because of lack of data on plant processing margins, and because of complexities arising out of inter-provincial differences in institutional arrangements and levels for raw material input price-setting. Instead, milk allocation is estimated as a set of production identity equations for cheese (QFC3), other dairy products (QODP3), and, as a residual, creamery butter (QCB3). The identities take into account opening and closing stocks, net international trade and aggregate domestic disappearance, this last being product of per-capita domestic disappearance (see Domestic Disappearance Block below) and Canadian population.

The majority of the stock-holding and international trade equations are specified as identities rather than stochastic estimations, either because of their lack of importance, or because of institutional arrangements negating or smothering market signals or because of estimation difficulties rooted in data inadequacies. Thus, for cheese and other dairy products, only closing stocks are estimated stochastically; for butter, none of the equations is stochastic; and for skim milk powder, only production and exports are estimated stochastically.

<u>Per-Capita Domestic Disappearance Block</u> - is comprised of seven stochastic equations, one for each of standard milk, low-fat

milk, creams, creamery butter, factory cheese, skim milk powder and other dairy products. The arguments borrow extensively from conventional demand theory, so that apparent per-capita domestic disappearance is a function of own retail price, prices of competing or complementary products, per-capita disposable income and a time trend reflecting changes in tastes and preferences of consumers. In the case of low-fat milk (PCLM3), no equitable competing or complementary product was found. For other dairy products, the composite character of the variable prevented the inclusion of any one competing or complementary variable's price. For the cream disappearance equation, retail price of fluid milk is used as a proxy for own price, there being no data series for the latter. Finally, seasonal influences were identified as important for disappearance of low-fat milk, cream, skim milk powder, and other dairy products.

Government Policy Block - the gross target return on industrial milk (XGTM3) is formula-driven by the change recorded in dairy cash costs of production (XDCC12), the consumer price index (CPI3) as a proxy for returns to dairy capital inputs, and industrial wage rates (WA3) as a proxy for returns to labour inputs, relative to the previous quarter's values. Adjustments to the gross target return can be made twice each year - in the first quarter (August 1) or in the third quarter (February 1).

The net target return on industrial milk (XNTM3) is equal to the gross return net of the in-quota holdback levy (XIQH3). The in-quota levy is a function of the volume of skim milk powder exports; differences between Canadian domestic support prices and (lower) world prices for skim milk powder, net of any CDC profits on international butterfat exchange transactions; and seasonal factors. Analogously, the producer return for over-quota industrial shipments (XPMOQ3) is equal to the gross target return net of direct subsidy payments (XSUM3) and the over-quota levy (XPNM3). The over-quota levy is a function of price differentials between Canadian and world markets for butter and skim milk powder, and of seasonal factors. It will be noted that the in-quota levy is based on estimated export disposal costs for surplus skim milk powder alone (butterfat being the market balancing factor within quota), but that the over-quota levy necessarily deals with export disposal costs for surplus fat and not-fat fractions of industrial milk. Direct subsidy payments unit rates have not been changed since their inauguration in 1975, therefore total supplementary payments to industrial milk and cream shippers (XCRDY3) are a product of unit subsidy rates and total shipments eligible to receive subsidy. The eligible total is the sum of estimated domestic requirements (XEDRM3) and the portion of the commercial export requirements eligible for subsidy (XSSPX3).

Wholesale prices for butter (XWPCB3) and skim milk powder (XWPPM3) are supported through offers to purchase by the CDC, and are derived from gross target returns, net of assumed processing

plant margins (XAPM3) and direct subsidies (XSUM3). Skim milk powder support prices are those for which major adjustments are made, according to any changes in gross target returns, processing margins and subsidies. This permits modest upward adjustments in butter support prices, the better to maintain butter's competitiveness in domestic markets. Butter support price adjustments are treated as a residual after the powder support price is accounted for. Assumed processing plant margins are adjusted according to changes in average industrial wage rates (WA3).

Prices of fluid milk at the farm level (XPFM2) are estimated stochastically from current and one-period lagged values for average industrial wage rates, and the dairy cash costs of production index (XDCCI2), being the principal components in the formulae for setting fluid milk prices in the two most important producing and consuming provinces, Ontario and Quebec. The endogenous price series is an average of these two provinces' fluid prices, and is taken to be representative of fluid price-setting mechanisms for all 10 provincial jurisdictions.

An approximation of total quota issued (XQM3) is the sum of estimated domestic requirements for industrial milk and cream (XEDRM3) and the previous four quarters' worth of milk shipped for fluid purposes (SMFP3), the policy objective being to issue only enough quota to fill the domestic industrial and fluid milk requirements. Domestic industrial milk and cream requirements are based on changes in butter inventories (ICB3); and on estimated

domestic disappearance (XMREQ3)(adjusted for Canadian exports and imports) of butter, cheese and other dairy products. An alternative assessment of industrial milk and cream quota issued (XMSQ3) is given by the sum of estimated domestic industrial milk and cream requirements (XEDRM3), special export (of industrial milk products) quota (XSPX3), and a flexibility allowance referred to as the "sleeve" (XSLV3). Shares of the national industrial milk and cream quota for Ontario (XMSQ21), Quebec (XMSQ22) and the Atlantic Provinces (XMSQ27), set at 31.1, 47.7 and 4.5 percent, respectively, are included to provide linkages with other components such as the pork sector of FARM.

Wholesale and Retail Price Block - due to the offers-to-purchase program providing support prices for butter and skim milk powder, wholesale prices for alternative dairy products are indirectly supported, and therefore are determined in the stochastic equations by butter and powder support prices. Inclusion of the food marketing cost index (FMCT03) in most equations is designed to account for wholesale and/or retail marketing margins. Lagged endogenous variables are included in most of the equations to reflect the importance of historical price levels in setting current prices. Retail prices for both processed and fluid dairy products are estimated from wholesale prices, adjusted for wholesale and retail marketing margins (FMCT03), and lagged endogenous variables.

Farm Cash Receipts from Dairying - this accounting equation sums total producer returns from the marketplace for both fluid and industrial milk and cream shipments.

Factory Price Index for Dairy Ration - this is estimated stochastically because it is based on the prices of components (corn and soybean meal) that are in turn estimated stochastically in the feed grains sub-model of FARM, thus providing direct linkages between the dairy and feed grains sub-models of FARM. Dairy ration costs are a function of corn prices (FPCO2), soybean meal prices (PSM2), lagged endogenous variable values and seasonal factors.

EMPIRICAL RESULTS

The econometric model is capable of providing descriptive, predictive and prescriptive types of information. Descriptive information is reported here in the form of a) parameter estimates; b) multipliers; and c) demand elasticities. The model has been used quite extensively for forecasting and policy evaluation work. This information is readily available from regulary updated FARM reports with Agriculture Canada.

Parameter Estimates - for the stochastic equations were obtained using ordinary least squares estimators and quarterly data series from 1971 to 1987. For the most part, coefficient signs are in accordance with theoretical expectations and the statistical

properties are acceptable. The full estimated results are shown in Appendix A.

Major Limitation of the Model

The notable problems are the equations for Inventory of Other Dairy Products (IODP3) which displays a low corrected multiple-correlation coefficient; Per-capita Disappearance of Creamery Butter (PCCB3), which shows a negative sign on the per-capita disposable income parameter; and Per-capita Disappearance of Skim Milk Powder (PCPM3), which carries a very low corrected multiple-correlation coefficient and statistically non-significant estimates for all parameters, although all estimates have the correct expected signs.

Multipliers: an example is provided of the impact on selected parameters of a 10-percent increase in gross target return on industrial milk (Table 2). An increase in the formula-driven target return would have resulted from a combined net increase during the previous dairy year of the three formula components: surveyed costs of production in dairying for the 70-percent most efficient producers included in the survey; interest rates; and the consumer price index. The increased target return is reflected in increased support prices for butter and skim milk powder (assuming no change in direct producer subsidies), which cause sympathetic increases in wholesale prices of other dairy products, and which are eventually transmitted to retail price levels. Higher retail

TABLE 2: SELECTED MULTIPLIER EFFECTS OF A 10-PERCENT INCREASE IN GROSS TARGET RETURNS TO PRODUCERS

Selected Variable	Farm 1988 Multiplier	Farm 1990 Multiplier
Gross target return ($/hL)	+10.0%	+10%
Support price of butter ($/kg)	+10.5	+10.5
Support price of skim milk powder ($/kg)	+9.6	+9.2
Wholesale price of cheese ($/kg)	+8.0	+6.6
CPI for dairy products (1981-100)	+2.4	+3.7
Disappearance of cheese (mil. kg)	-3.5	-4.0
Disappearance of butter (mil. kg)	-5.9	-9.0
Shipments of industrial milk (mil. hL)	-5.9	-8.0
Industrial milk requirements (mil. hL)	-6.0	-8.0
Cash receipts ($/mil)	+3.5	+1.5

prices negatively affect domestic disappearance and, through reduced quotas, producer milk shipments. Cash receipts from dairying are shown to increase, despite the reduced shipments.

Elasticities: are calculated on a per-capita, short-term basis from the domestic disappearance block parameters of the econometric model for butter, cheese, and other dairy products (Table 3). Comparisons with other researchers' estimates for butter and cheese elasticities reveal close similarities in the case of cross-price elasticity for butter, reasonably close similarities for own price elasticities, but wide variations for income/expenditure elasticities. The significant increase in the butter own price elasticity estimates between 1983 and 1990 using the FARM model is indicative of extensive specification and estimation problems with the equation for per-capita disappearance of butter. The proximity of the 1990 estimate of -0.90 to other researchers' estimates is, in particular, reflective of the use of constraints in this equation. In the absence of constraints, unrealistically high estimates are obtained for own price elasticity in an equation specifying per-capita disappearance of butter as a function of own price, price of margarine, disposable income, and a trend variable.

Elasticities for fluid milk are not included in Table 3 since they are directly readable from the estimation results for the double log functional form of the equation (see Appendix A).

TABLE 3: SHORT-RUN ELASTICITIES CALCULATED FROM DOMESTIC DISAPPEARANCE BLOCK PARAMETERS

	Own Price	Cross Price[b]	Income/ Expenditure
Butter	-0.86	0.20	0.3 (Hassan/76)
	-0.83	0.2	0.2 (Curtin/86)
	-0.57	0.2	0.28 (FARM/83)
	-0.92	0.2	0.1 (FARM/90)
Cheese	-0.9		0.53 (Hassan/76)
	-0.75		0.32 (Curtin/86)
	-0.7	.03	0.79 (FARM/90)
Other Products[a]	-1.2		(FARM/90)

[a] Other products include evaporated milk, ice cream and yogurt.
[b] Cross-price commodity for butter is margarine, and for cheese is beef.

CONCLUDING REMARKS

The econometric model is capable of providing information of both a descriptive and a predictive nature. In addition, the model has been used for evaluating policy alternatives. From the structural analysis, the statistical tests indicate that the model in its up-dated and revised form is performing creditably well, and now provides descriptive and predictive information on a dairy-year and dairy-quarter basis. The information in this form is more relevant and useful to dairy industry decision-makers and policy-formulators.

Several exceptions to an otherwise well-performing model are indicative of the need for further research work on some of the equations. In the case of disappearance for butter and other dairy products, it is recommended that factors influencing shifts in demand be investigated. New equation specifications could perhaps employ translating or scaling techniques in order to incorporate demand shift parameters explicitly. In the case of the skim milk powder equations, improvements in the data series for production, stocks, trade and domestic disappearance should be sought (through, for example, requested changes in data reporting/collection procedures), in addition to the specification of improved stochastic equations. Further work is also required in the area of specifying and forecasting quota values. Longer time series data for these relatively new parameters would obviously assist in obtaining more accurate estimates and more reliable forecasts;

however, more sophisticated stochastic equations also have a potential contribution to make.

REFERENCES

Agriculture Canada. 1980-1986. Food and Agriculture Regional Model. Series of working papers through Policy, Planning and Economics Branch. Ottawa, Ontario.

Caine, R.J.H. and D.P. Stonehouse. 1983. "Adjusting the Seasonality of Milk Shipments in Canada: Problems, Economic Impacts and Potential Policies". Can. J. Agr. Econ. 31(2): 331-350.

Canadian Dairy Commission. Annual Report 1966-67. Ottawa, Ontario.

Canadian Dairy Commission. Annual Report 1987-88. Ottawa, Ontario.

Hassan, Z.A. and S.R. Johnson. 1976. "Consumer Demand for Major Foods in Canada". Publication No. 76/2. Policy and Economics Branch, Agriculture Canada. Ottawa Ontario.

Lu, W.F. and R.G. Marshall. 1973. "A Demand Analysis for Fluid Milk in Ontario." School o fAgricultural Economics and Extension Education, University of Guelph. Guelph, Ontario.

Perkins, B.B., J.H. Clark and R.G. Marshall. 1969. Canadian Dairy Policies, a Report to the Federal Task Force on Agriculture. Ottawa, Ontario.

Rausser, G.C. and D.P. Stonehouse. 1978. "Public Intervention and Producer Supply Response". J. Agric. Econ. 60(5):885-890.

Sahi, R.K. and D.H. Harrington. 1974. "A Note on Econometric Simulation Model for Canadian Dairy Industry". Can. J. Agr. Econ. Proceedings of Workshop: 114-132.

Shefrin, F., D. Cavin and Z. Yankowsky. 1967. "Demand-Supply Projections for Canadian Agriculture, 1980." Project No. 16., Federal Task Force on Agriculture. Ottawa, Ontario.

Stonehouse, D.P., D.H. Harrington and R.K. Sahi. 1978. "An Econometric Forecasting and Policy Analysis Model of the Canadian Dairy Industry", in H.B. Huff and Z.A. Hassan, eds., Commodity Forecasting Models for Canadian Agriculture Vol I. Agriculture Canada, Economics Branch. Ottawa, Ontario.

Stonehouse, D.P. 1979. "Government Policies for the Canadian Dairy Industry". Can. Farm Econ. 13(1):1-12.

Stonehouse, D.P. and G.C. Rausser. 1981. "A Quarterly Econometric

Model of the Canadian Dairy Industry with Endogenous Policy Variables". School of Agricultural Economics and Extension Education, University of Guelph. Working Paper AEEE 81/7. Guelph, Ontario.

Stonehouse, D.P. 1987. **"A Profile of the Canadian Dairy Industry and Government Policies."** Policy Branch, Agriculture Canada. Working Paper 4/87. Ottawa, Ontario.

Stonehouse, D.P. and J. Tabi. 1988. **"An Assessment of the Economic Viability of Cream-Producing Enterprises in Ontario".** Report to Ontario Cream Producers Marketing Board. Department of Agricultural Economics and Business, University of Guelph. Guelph, Ontario.

Stonehouse, D.P., G.L. Brinkman, M.A. MacGregor and J. Tabi. **"A Methodology for Evaluating Maximum Profitable Bids for Quota in the Ontario Dairy Industry".** Department of Agricultural Economics and Business, University of Guelph. (forthcoming).

Tabi, J., D.P. Stonehouse and M.A. MacGregor. 1987. **"A Statistical Analysis of Ontario Quota Exchange Participants".** Department of Agricultural Economics and Business, University of Guelph. Technical Bulletin AEB/87/9.

APPENDIX A

COMPLETE ESTIMATION RESULTS

FOR

ECONOMETRIC MODEL

WITH

STATISTICAL PROPERTIES

ESTIMATION RESULTS[1]

SUPPLY BLOCK:

SHIPMENTS OF INDUSTRIAL MILK AND CREAM

```
SMMC3 = SMMC3.1*JS1*XMSQ3+1*JS2*(XMSQ3-SMMC3(-1)-SMMC3(-2)-SMMC3(-3))
        +SMMC3.3*JS3*XMSQ3+SMMC3.4*JS4*XMSQ3
```

NOB = 16	NOVAR = 3	NCOEF = 3	RANGE: 1984 1 TO 1987 4
RSQ = 0.9991	CRSQ = 0.999	F(3/13) = NA	PROB>F = NA
SER = 0.3158	DW(0) = 1.8664	COND = 1.	LHS MEAN = 8.5356

COEF	ESTIMATE	TSTAT	MEAN	STDEV
SMMC3.1	0.2429	72.3833	11.7645	21.0462
SMMC3.3	0.2493	74.2198	11.7523	21.0237
SMMC3.4	0.2252	66.9936	11.7458	21.0122

SHIPMENTS OF FLUID MILK

```
SMFP3 = SMFP3.0+SMFP3.1*DLM3+SMFP3.2*DMS3+SMFP3.3*D1975+SMFP3.4*DCRM3+SMFP3.5*SMFP3(-1)
```

NOB = 96	NOVAR = 6	NCOEF = 6	RANGE: 1965 1 TO 1988 4
RSQ = 0.9553	CRSQ = 0.9528	F(5/90) =384.282	PROB>F = 0.
SER = 0.1368	DW(0) = 1.7198	COND = 157.376	LHS MEAN = 6.3058

COEF	ESTIMATE	TSTAT	MEAN	STDEV
SMFP3.0	-2.8455	-3.6009	1.	0.
SMFP3.1	6.461E-03	9.1186	311.022	117.306
SMFP3.2	1.238E-02	7.1835	266.14	52.0897
SMFP3.3	-0.1441	-2.1661	0.5833	0.4956
SMFP3.4	1.335E-02	7.5007	82.4525	22.0888
SMFP3.5	0.4505	6.7527	6.2842	0.6147

SHIPMENTS OF FARM-SEPARATED CREAM

```
SFSC3 = SFSC3.0+(SFSC3.1+SFSC3.2*JS1+SFSC3.3*JS2+SFSC3.4*JS3)*LOG(TIME)
        +SFSC3.5*(4.365*XWPCB3(-4)-XAPM3(-4)/2+XSUM3(-4))
        +SFSC3.6*(XWPPM3(-4)*8.54-XAPM3(-4)/2)
```

NOB = 32	NOVAR = 7	NCOEF = 7	RANGE: 1980 1 TO 1987 4
RSQ = 0.9427	CRSQ = 0.9289	F(6/25) = 68.495	PROB>F = 0.
SER = 3.407E-02	DW(0) = 2.0195	COND =1037.53	LHS MEAN = 0.5105

COEF	ESTIMATE	TSTAT	MEAN	STDEV
SFSC3.0	2.8961	1.7791	1.	0.
SFSC3.1	-0.6178	-1.3626	4.6453	9.026E-02
SFSC3.2	8.620E-03	2.3323	1.1577	2.0378
SFSC3.3	5.863E-02	15.8702	1.1601	2.042
SFSC3.4	3.961E-02	10.6948	1.1625	2.0463
SFSC3.5	6.206E-02	0.933	21.4643	2.4619
SFSC3.6	-5.254E-02	-1.0786	18.502	2.8928

---

[1]E-NOTATION: 6.461E-03=0.006461

SUPPLY OF "SKIM-OFF CREAM" FROM FLUID PROC. TO INDUST. MILK SECTOR

SSOC3-SSOC3(-1) = SSOC3.1*(DCRM3-DCRM3(-1))+SSOC3.2*(DLM3-DLM3(-1))+SSOC3.3*(DMS3-DMS3(-1))

NOB = 92	NOVAR = 3	NCOEF = 3	RANGE: 1966 1 TO 1988 4
RSQ = 0.9518	CRSQ = 0.9507	F(3/89) = NA	PROB>F = NA
SER = 2.264E-02	DW(0) = 2.1419	COND = 1.9086	LHS MEAN = 080E-02

COEF	ESTIMATE	TSTAT	MEAN	STDEV
SSOC3.1	-8.894E-03	-26.8557	0.7221	7.7159
SSOC3.2	4.831E-03	16.8409	4.0618	9.1931
SSOC3.3	1.004E-03	2.5791	-2.0028	6.6372

INVENTORY OF DAIRY COWS

IDC3S =(JS2+JS4)*IDC3S.0+IDC3S.1*(SMKC3+SMKC3(-1))/2+IDC3S.2*FPDR2(-1)
+IDC3S.3*RPRIME3(-1)+IDC3S.4*PBW2(-1)+IDC3S.5*IDH3S(-2)
+IDC3S.6*IDC3S(-2)+IDC3S.7*TIME)

NOB = 92	NOVAR = 8	NCOEF = 8	RANGE: 1966 1 TO 1988 4
RSQ = 0.9999	CRSQ = 0.9999	F(8/84) = NA	PROB>F = NA
SER = 15.362	DW(0) = 1.9441	COND = 341.297	LHS MEAN = 71.981

COEF	ESTIMATE	TSTAT	MEAN	STDEV
IDC3S.0	1515.29	7.5336	0.5	0.5027
IDC3S.1	13.8761	6.1538	9.1352	9.2222
IDC3S.2	0.3968	2.8889	96.706	110.98
IDC3S.3	-0.2904	-0.2068	4.9982	5.5806
IDC3S.4	-0.877	-2.3821	19.3899	22.498
IDC3S.5	0.4071	4.3089	362.032	366.376
IDC3S.6	0.2742	3.1348	984.672	1018.21
IDC3S.7	-8.8553	-8.0357	39.5	43.9746

INVENTORY OF DAIRY HEIFERS

IDH3S = (JS2+JS4)*(IDH3S.1*(IDC3S(-4)+IDC3S(-6))/2+IDH3S.2*PHF2(-1)
+IDH3S.3*FPDR2(-1))

NOB = 38	NOVAR = 3	NCOEF = 3	RANGE: 1978 1 TO 1987 2
RSQ = 0.9989	CRSQ = 0.9989	F(3/35) = NA	PROB>F = NA
SER = 16.5707	DW(0) = 1.8851	COND = 25.8405	LHS MEAN = 45.765

COEF	ESTIMATE	TSTAT	MEAN	STDEV
IDH3S.1	0.2561	19.107	873.427	889.124
IDH3S.2	1.631	2.8754	37.583	38.5624
IDH3S.3	0.466	2.9987	130.269	134.176

VALUE OF "USED" MARKET SHARING QUOTA

USEDONT4 = MSQ21.0+MSQ21.1*JS1+MSQ21.2*JS2+MSQ21.3*JS3+MSQ21.4*XNTM3/FPDR2
+MSQ21.5*PHG2/FPCO2+MSQ21.7*RFC3

NOB = 32	NOVAR = 7	NCOEF = 7	RANGE: 1981 1 TO 1988 4
RSQ = 0.8258	CRSQ = 0.784	F(6/25) = 19.75	PROB>F = 0.
SER = 2.1558	DW(0) = 0.9309	COND = 47.8949	LHS MEAN = 14.6438

COEF	ESTIMATE	TSTAT	MEAN	STDEV
MSQ21.0	16.9264	2.6949	1.	0.
MSQ21.1	0.8579	0.7905	0.25	0.4399
MSQ21.2	1.9427	1.7842	0.25	0.4399
MSQ21.3	4.6492	4.2804	0.25	0.4399
MSQ21.4	82.062	2.0874	0.1421	1.765E-02
MSQ21.5	-3.5133	-3.0425	1.4223	0.4507
MSQ21.7	-0.9618	-5.8045	11.2359	3.4125

DAIRY PROCESSING BLOCK:

CLOSING INVENTORIES OF FACTORY CHEESE

```
CIFC3 = CIFC3.0+CIFC3.1*JS1+CIFC3.2*JS2+CIFC3.3*JS3+
        CIFC3.4*(DFC3-SUM(I = -4 TO -1 : DFC3(I)/4))+(CIFC3.5+CIFC3.7*TIME)*QFC3+CIFC3.6*CIFC3(-1)
```

```
NOB = 46       NOVAR = 8          NCOEF = 8        RANGE:  1976 1  TO  1987 2
RSQ = 0.9755   CRSQ =  0.971      F(7/38) =216.49  PROB>F = 0.
SER = 1.1991   DW(0) = 1.0664     COND = 110.369   LHS MEAN =  46.4212
```

COEF	ESTIMATE	TSTAT	MEAN	STDEV
CIFC3.0	-16.4747	-5.3994	1.	0.
CIFC3.1	-0.2116	-0.4194	0.2609	0.444
CIFC3.2	0.6994	1.1569	0.2609	0.444
CIFC3.3	-0.7905	-1.0132	0.2391	0.4313
CIFC3.4	-0.4926	-5.5199	1.3718	3.2866
CIFC3.5	1.0793	6.8766	44.5308	8.7058
CIFC3.6	0.9007	26.3573	46.0778	7.164
CIFC3.7	-5.951E-03	-6.3587	4357.39	1420.93

CLOSING INVENTORIES OF OTHER DAIRY PRODUCTS

```
IODP3 = IODP3.0+IODP3.1*JS1+IODP3.2*JS2+IODP3.3*JS3+IODP3.4*QODP3
        +IODP3.5*DODP3(-1)+IODP3.6*IODP3(-1)
```

```
NOB = 52       NOVAR = 7          NCOEF = 7        RANGE:  1976 1  TO  1988 4
RSQ = 0.6779   CRSQ =  0.635      F(6/45) = 15.78  PROB>F = 0.
SER = 0.1021   DW(0) = 1.9192     COND =  38.2753  LHS MEAN =   0.3581
```

COEF	ESTIMATE	TSTAT	MEAN	STDEV
IODP3.0	0.1672	0.864	1.	0.
IODP3.1	-0.1562	-2.4135	0.25	0.4372
IODP3.2	-0.152	-1.8428	0.25	0.4372
IODP3.3	-8.826E-03	-0.1584	0.25	0.4372
IODP3.4	0.2304	4.368	2.3704	0.5149
IODP3.5	-0.2312	-2.5953	1.8804	0.3618
IODP3.6	0.4398	4.2362	0.361	0.1667

PRODUCTION OF SKIM MILK POWDER

```
LOG(QPM3) = QPM3.0+(QPM3.1*JS1+QPM3.2*JS2+QPM3.3*JS3)
            *LOG(QCB3-SSOC3/4.365-SFSC3/4.365)
            +QPM3.4*LOG(QODP3/(SMMC3-SFSC3))
```

```
NOB = 46       NOVAR = 5          NCOEF = 5        RANGE:  1976 1  TO  1987 2
RSQ = 0.8003   CRSQ =  0.7808     F(4/41) = 41.084 PROB>F = 0.
SER = 0.1934   DW(0) = 1.0557     COND =  31.0432  LHS MEAN =   3.3914
```

COEF	ESTIMATE	TSTAT	MEAN	STDEV
QPM3.0	1.5145	4.0278	1.	0.
QPM3.1	0.1271	4.9703	0.8217	1.3995
QPM3.2	0.2831	12.2741	0.9121	1.5546
QPM3.3	0.1728	6.9069	0.7865	1.4199
QPM3.4	-0.897	-3.7268	-1.5365	0.1202

EXPORTS OF SKIN MILK POWDER

```
EXSMP3 = (EXSMP3.1*JS1+EXSMP3.2*JS2+EXSMP3.3*JS3+EXSMP3.4*JS4)
        *QPM3+IPM3(-1))+EXSMP3.5*XWPPM3+EXSMP3.6*EXSMP3(-1)
```

NOB = 38	NOVAR = 6	NCOEF = 6	RANGE: 1978 1 TO 1987 2
RSQ = 0.8848	CRSQ = 0.8668	F(6/32) = NA	PROB>F = NA
SER = 8.2409	DW(0) = 2.1402	COND = 6.8044	LHS MEAN = 19.7609

COEF	ESTIMATE	TSTAT	MEAN	STDEV
EXSMP3.1	0.2587	2.5985	13.1188	23.5186
EXSMP3.2	0.3257	5.0874	18.6494	32.5414
EXSMP3.3	0.2381	3.3574	16.7191	31.7071
EXSMP3.4	0.4213	5.3854	13.5591	26.7338
EXSMP3.5	-0.9301	-0.5968	2.4406	0.4683
EXSMP3.6	0.1345	0.9997	20.2036	10.7253

PER-CAPITA DOMESTIC DISAPPEARANCE BLOCK:

PER-CAPITA DISAPPEARANCE OF STANDARD MILK

```
PCMS3 = PCMS3.0+PCMS3.1*JS1+PCMS3.2*JS2+PCMS3.3*JS3+PCMS3.4*RPWFM3
       +PCMS3.5*RPOJ3+PCMS3.6*TIME+PCMS3.7*PCDY3
```

NOB = 96	NOVAR = 8	NCOEF = 8	RANGE: 1965 1 TO 1988 4
RSQ = 0.9955	CRSQ = 0.9951	F(7/88) =771.14	PROB>F = 0.
SER = 0.2292	DW(0) = 0.9301	COND = 72.4915	LHS MEAN = 11.8434

COEF	ESTIMATE	TSTAT	MEAN	STDEV
PCMS3.0	22.4802	132.826	1.	0.
PCMS3.1	-0.1607	-2.2685	0.25	0.4353
PCMS3.2	-0.3127	-4.7088	0.25	0.4353
PCMS3.3	-0.1594	-2.1573	0.25	0.4353
PCMS3.4	-1.117E-02	-1.5468	73.0055	38.4886
PCMS3.5	8.133E-03	2.615	73.6298	37.8533
PCMS3.6	-0.1662	-37.753	76.5	27.8568
PCMS3.7	1.418E-03	5.9209	1731.6	1096.53

PER-CAPITA DISAPPEARANCE OF LOW-FAT MILK

```
LOG(PCLM3) = PCLM3.0+PCLM3.2*JS2+PCLM3.3*JS3+PCLM3.4*LOG(RPLFM3/CPI3)
            +PCLM3.5* LOG(PCDY3/CPI3)+PCLM3.6*LOG(TIME)
```

NOB = 38	NOVAR = 6	NCOEF = 6	RANGE: 1978 1 TO 1987 2
RSQ = 0.9727	CRSQ = 0.9684	F(5/32) =228.011	PROB>F = 0.
SER = 1.151E-02	DW(0) = 1.5418	COND = 300.256	LHS MEAN = 2.81

COEF	ESTIMATE	TSTAT	MEAN	STDEV
PCLM3.0	2.345E-02	0.1538	1.	0.
PCLM3.2	-4.386E-02	-8.4758	0.2632	0.4463
PCLM3.3	-2.828E-02	-3.1309	0.2368	0.4309
PCLM3.4	-0.3111	-4.1297	-4.895E-02	3.006E-02
PCLM3.5	0.2399	3.4951	3.1838	6.059E-02
PCLM3.6	0.4409	15.6879	4.594	0.1127

PER-CAPITA DISAPPEARANCE OF CREAM

```
PCCRM3 = PCCRM3.0+PCCRM3.1*JS1+PCCRM3.2*JS2+PCCRM3.3*JS3+PCCRM3.5*PCDY3
        +PCCRM3.6*RPFO3+PCCRM3.8*RPFM3
```

NOB = 35	NOVAR = 7	NCOEF = 7	RANGE: 1978 4 TO 1987 2
RSQ = 0.9468	CRSQ = 0.9354	F(6/28) = 83.05	PROB>F = 0.
SER = 0.1442	DW(0) = 1.4287	COND = 97.7028	LHS MEAN = 4.0384

COEF	ESTIMATE	TSTAT	MEAN	STDEV
PCCRM3.0	1.3103	4.7784	1.	0.
PCCRM3.1	-0.1779	-2.2812	0.2571	0.4434
PCCRM3.2	0.2011	2.9272	0.2571	0.4434
PCCRM3.3	-0.4643	-4.8879	0.2286	0.426
PCCRM3.5	1.497E-03	5.6333	2694.5	546.08
PCCRM3.6	1.764E-02	3.3923	108.443	13.3097
PCCRM3.8	-2.903E-02	-3.7233	107.378	18.355

PER-CAPITA DISAPPEARANCE OF CREAMERY BUTTER

```
LOG(PCCB3) = PCCB3.0-PCCB3.R*PCCB3.0+PCCB3.1*(JS1-PCCB3.R*JS1(-1))
            +PCCB3.2*(JS2-PCCB3.R*JS2(-1))+PCCB3.3*(JS3-PCCB3.R*JS3(-1))
            +PCCB3.4*(LOG(RPCB3/CPI3)-PCCB3.R*LOG(RPCB3(-1)/CPI3(-1)))
            +0.2*(LOG(RPMG3/CPI3)-PCCB3.R*0.2*LOG(RPMG3(-1)/CPI3(-1)))
            +0.1*(LOG(PCDY3/CPI3)-PCCB3.R*0.1*LOG(PCDY3(-1)/CPI3(-1)))
            +PCCB3.5*(LOG(TIME)-PCCB3.R*LOG(TIME(-1)))
            +PCCB3.R*LOG(PCCB3(-1))
```

NOB = 92	NOVAR = 7	NCOEF = 7	RANGE: 1966 1 TO 1988 4
RSQ = 0.9339	CRSQ = 0.9293	F(14/85) =200.2	PROB>F = 0.
SER = 6.525E-02	DW(0) = 2.0287	COND = 49.0918	LHS MEAN = 0.2661

COEF	ESTIMATE	TSTAT	MEAN	STDEV
PCCB3.R	0.5986	3.9522	-0.6747	7.142E-02
PCCB3.0	2.2815	10.2658	-0.4014	0.
PCCB3.1	-8.369E-02	-5.7561	-0.1003	0.5772
PCCB3.2	-7.575E-02	-4.5638	-0.1003	0.5772
PCCB3.3	-5.001E-02	-3.4574	-0.1003	0.5772
PCCB3.4	-0.9169	-2.8791	2.323E-02	2.815E-02
PCCB3.5	-0.6333	-7.5901	-1.7342	0.1462

PER-CAPITA DISAPPEARANCE OF FACTORY CHEESE

```
LOG(PCFC3) = BPCFC3+PCFC3.0+PCFC3.1*LOG(RPCH3/CPI3)+PCFC3.2*LOG(RPBF3/CPI3)
            +PCFC3.3*LOG(PCDY3/CPI3)+PCFC3.5*TIME
```

NOB = 96	NOVAR = 5	NCOEF = 5	RANGE: 1965 1 TO 1988 4
RSQ = 0.958	CRSQ = 0.9561	F(4/91) =518.57	PROB>F = 0.
SER = 6.808E-02	DW(0) = 2.2841	COND = 111.227	LHS MEAN = 0.4522

COEF	ESTIMATE	TSTAT	MEAN	STDEV
PCFC3.0	-2.6296	-9.4364	1.	0.
PCFC3.1	-0.678	-3.4583	-8.921E-02	0.1344
PCFC3.2	3.228E-02	0.4885	-0.1574	0.1228
PCFC3.3	0.7855	8.3963	3.0149	0.2165
PCFC3.5	8.604E-03	8.6859	76.5	27.8568

PER-CAPITA DISAPPEARANCE OF SKIM MILK POWDER

```
PCPM3 =  PCPM3.0+PCPM3.1*JS1+PCPM3.2*JS2+PCPM3.3*JS3
        +PCPM3.4*LOG(PCDY3/CPI3)+PCPM3.6*LOG(RPPM3/CPI3)
        +PCPM3.7*LOG(RPFM3/CPI3)
```

```
NOB = 38       NOVAR = 7          NCOEF = 7        RANGE:  1978 1  TO  1987 2
RSQ = 0.1285   CRSQ =.019E-02     F(6/31) =  0.76  PROB>F = 0.6054
SER = 0.2568   DW(0) = 2.7948     COND = 291.344   LHS MEAN =   0.4778
```

COEF	ESTIMATE	TSTAT	MEAN	STDEV
PCPM3.0	-4.8745	-1.079	1.	0.
PCPM3.1	-1.588E-02	-0.1176	0.2632	0.4463
PCPM3.2	-0.1478	-1.2265	0.2632	0.4463
PCPM3.3	-0.1201	-0.705	0.2368	0.4309
PCPM3.4	1.7118	1.2046	3.1838	6.059E-02
PCPM3.6	-8.576E-02	-0.1446	-1.602E-02	8.947E-02
PCPM3.7	0.9418	0.463	-2.930E-02	2.147E-02

PER-CAPITA DISAPPEARANCE OF OTHER DAIRY PRODUCTS

```
LOG(PCODP3) = BPCODP3+PCODP3.0+PCODP3.1*JS1+PCODP3.2*JS2+PCODP3.3*JS3
             +PCODP3.4*LOG((4.41*XWPCB3+8.54*XWPPM3)/CPI3)
             +PCODP3.5*LOG(TIME)
```

```
NOB = 34       NOVAR = 6          NCOEF = 6        RANGE:  1978 1  TO  1986 2
RSQ = 0.823    CRSQ =  0.7914     F(5/28) = 26.04  PROB>F = 0.
SER = 9.928E-02 DW(0) = 2.5233    COND = 237.317   LHS MEAN =  -2.587
```

COEF	ESTIMAT	TSTAT	MEAN	STDEV
PCODP3.0	-3.4011	-2.0657	1.	0.
PCODP3.1	0.1338	2.761	0.2647	0.4478
PCODP3.2	0.4998	10.3015	0.2647	0.4478
PCODP3.3	0.3411	6.7327	0.2353	0.4306
PCODP3.4	-1.1704	-0.9319	-1.0131	1.477E-02
PCODP3.5	-0.1355	-0.784	4.5747	0.1029

GOVERNMENT POLICY BLOCK:

INDUSTRIAL MILK AND CREAM REQUIREMENTS AS PUBLISHED BY CDC

```
XEDRM3 = (IF JS1+JS3 EQ 1 THEN (16-SUM(I = -4 TO -1 : ICB3(I)/4))
         *0.2273+XEDRM3.1*SUM(I = -3 TO 0 : XMREQ3(I)) ELSE XEDRM3(-1))
```

```
NOB = 28       NOVAR = 1          NCOEF = 1        RANGE:  1980 1  TO  1986 4
RSQ = 0.9986   CRSQ =  0.9986     F(1/27) =  NA    PROB>F = NA
SER = 1.2634   DW(0) = 1.9812     COND =   1.      LHS MEAN =  23.4302
```

COEF	ESTIMATE	TSTAT	MEAN	STDEV
XEDRM3.1	1.0618	138.774	22.0606	22.4764

ASSUMED DAIRY PROCESSING PLANT MARGIN

```
XAPM3 = (IF JS3 EQ 1 THEN XAPM3.0+XAPM3.1*WA3(-1) ELSE XAPM3(-1))
```

```
NOB = 68       NOVAR = 2          NCOEF = 2        RANGE:  1971 1  TO  1987 4
RSQ = 0.9965   CRSQ =  0.9965     F(2/66) =  NA    PROB>F = NA
SER = 0.1462   DW(0) = 1.1967     COND =   5.4166  LHS MEAN =   1.2006
```

COEF	ESTIMAT	TSTAT	MEAN	STDEV
XAPM3.0	-5.882E-02	-0.5924	0.25	0.4362
XAPM3.1	1.653E-02	49.7865	69.8218	133.175

AVERAGE PRICE OF FLUID MILK AT FARM LEVEL

```
XPFM2 = XPFM2.0+XPFM2.1*WA3-XPFM2.R*XPFM2.1*WA3(-1)
        +XPFM2.2*XDCC12-XPFM2.R*XPFM2.2*XDCC12(-1)+XPFM2.R*XPFM2(-1)
```

NOB = 36	NOVAR = 4	NCOEF = 4	RANGE: 1980 1 TO 1988 4
RSQ = 0.9878	CRSQ = 0.9866	F(4/32) =860.642	PROB>F = 0.
SER = 0.6067	DW(0) = 1.9202	COND = 42.389	LHS MEAN = 47.325

COEF	ESTIMATE	TSTAT	MEAN	STDEV
XPFM2.R	0.9352	38.212	-37.0235	4.3555
XPFM2.0	2.8068	1.5269	-1.	0.
XPFM2.1	1.704E-02	0.508	-30.483	2.7963
XPFM2.2	0.1536	0.4468	-1.5549	0.3509

IN-QUOTA HOLDBACK LEVY ON INDUSTRIAL MILK

```
XIQM3 = XIQM3.1*JS3*((IPM3(-1)-20
        +SUM(I = -4 TO-1:EXSMP3(I)))*(XWPPM3-EXPPM3(-1))
         +XSPX3*XPNM3-FLUIDLV3*SUM(I = -4 TO -1:SHFP3(I))-IMCB3
         *(XWPCB3-UVLBTNZ/1000))/(XEDRM3+XSPX3)
         +JS1*XIQM3(-1)+JS2*XIQM3(-1)+JS4*XIQM3(-1)
```

NOB = 28	NOVAR = 1	NCOEF = 1	RANGE: 1980 1 TO 1986 4
RSQ = 0.9132	CRSQ = 0.9132	F(1/27) = NA	PROB>F = NA
SER = 0.7291	DW(0) = 2.0427	COND = 1.	LHS MEAN = 1.2193

COEF	ESTIMATE	TSTAT	MEAN	STDEV
XIQM3.1	1.0173	16.8539	1.0982	2.0379

OVER-QUOTA LEVY ON INDUSTRIAL MILK

```
XPNM3 = JS3*(XPNM3.0+XPNM3.1*(8.54*(XWPPM3-EXPPM3)+4.41*(XWPCB3-UVLBTNZ)))
        +(JS4+JS1+JS2)*XPNM3(-1)
```

NOB = 32	NOVAR = 2	NCOEF = 2	RANGE: 1980 1 TO 1987 4
RSQ = 0.9933	CRSQ = 0.9931	F(2/30) = NA	PROB>F = NA
SER = 1.3083	DW(0) = 1.5145	COND = 9.7985	LHS MEAN = 7.6669

COEF	ESTIMATE	TSTAT	MEAN	STDEV
XPNM3.0	-5.0831	-2.22	0.25	0.4399
XPNM3.1	1.3754	15.6566	6.3817	11.5445

WHOLESALE BLOCK:

WHOLESALE PRICE OF CHEDDAR CHEESE

```
WPCH3 = WPCH3.0+WPCH3.1*(4.365*XWPCB3+8.54*XWPPM3)+WPCH3.2*FMCT03
```

NOB = 72	NOVAR = 3	NCOEF = 3	RANGE: 1971 1 TO 1988 4
RSQ = 0.9984	CRSQ = 0.9984	F(2/69) =22042.6	PROB>F = 0.
SER = 5.479E-02	DW(0) = 1.1219	COND = 64.0191	LHS MEAN = 3.3619

COEF	ESTIMATE	TSTAT	MEAN	STDEV
WPCH3.0	-3.048E-02	-1.3731	1.	0.
WPCH3.1	7.268E-02	14.8723	31.2294	12.9293
WPCH3.2	1.257E-02	6.7585	89.2894	33.9661

WHOLESALE PRICE INDEX OF EVAPORATED MILK

```
WPEM3/WPEM3(-1) = WPEM3.1*(4.365*XWPCB3+8.54*XWPPM3)/(4.365*XWPCB3(-1)
                  +8.54*XWPPM3(-1))

NOB = 68        NOVAR = 1          NCOEF = 1        RANGE:  1972 1  TO  1988 4
RSQ = 0.9998    CRSQ =  0.9998     F(1/67) =  NA    PROB>F = NA
SER = 1.306E-02 DW(0) = 1.4899     COND =   1.      LHS MEAN =   1.0235

COEF              ESTIMATE   TSTAT          MEAN        STDEV
WPEM3.1           1.0017     646.404          1.0217    2.700E-02
```

WHOLESALE PRICE INDEX OF ICE-CREAM

```
WPIC3/WPIC3(-1) = WPIC3.1*(4.365*XWPCB3+8.54*XWPPM3)/(4.365*XWPCB3(-1)
                  +8.54*XWPPM3(-1))

NOB = 72        NOVAR = 1          NCOEF = 1        RANGE:  1971 1  TO  1988 4
RSQ = 0.9857    CRSQ =  0.9857     F(1/71) =  NA    PROB>F = NA
SER = 0.1219    DW(0) = 0.9849     COND =   1.      LHS MEAN =   1.007

COEF              ESTIMATE    TSTAT     PROB>|T|   MEAN        STDEV
WPIC3.1           0.9848      70.0802     0.         1.0223    2.670E-02
```

RETAIL BLOCK:

CONSUMER PRICE INDEX FOR FLUID MILK

```
LOG(RPFM3/RPFM3(-1)) = RPFM3.0*LOG((0.26*RPWFM3+0.59*RPLFM3)/(0.26*RPWFM3(-1)
                       +0.59*RPLFM3(-1)))

NOB = 70        NOVAR = 1          NCOEF = 1        RANGE:  1971 1  TO  1988 2
RSQ = 0.9942    CRSQ =  0.9942     F(1/69) =  NA    PROB>F = NA
SER = 2.274E-03 DW(0) = 1.6113     COND =   1.      LHS MEAN =  897E-02

COEF              ESTIMATE   TSTAT          MEAN        STDEV
RPFM3.0           0.9919     108.521        1.873E-02   2.326E-02
```

CONSUMER PRICE INDEX FOR WHOLE (STANDARD) FLUID MILK

```
LOG(RPWFM3) = RPWFM3.0+RPWFM3.1*LOG(XPFM2)+RPWFM3.3*LOG(FMCTO3)
              +RPWFM3.4*(IF YEARQ GE 19734 AND YEARQ LE 19743 THEN 1 ELSE 0)
               +RPWFM3.5*LOG(RPWFM3(-1))

NOB = 70        NOVAR = 5          NCOEF = 5        RANGE:  1971 1  TO  1988 2
RSQ = 0.9994    CRSQ =  0.9993     F(4/65) = 26398.9 PROB>F = 0.
SER = 1.124E-02 DW(0) = 1.2548     COND = 462.621   LHS MEAN =   4.357

COEF              ESTIMATE       TSTAT          MEAN        STDEV
RPWFM3.0            0.1744       6.9267           1.          0.
RPWFM3.1            0.4236      13.5199           3.4929      0.4024
RPWFM3.3            0.274        6.086            4.3973      0.4089
RPWFM3.4         -6.426E-02     -8.353          5.714E-02    0.2338
RPWFM3.5            0.3462       6.2303           4.3377      0.4443
```

CONSUMER PRICE INDEX FOR LOW-FAT FLUID MILK

```
LOG(RPLFM3) = RPLFM3.0+RPLFM3.1*LOG(XPFM2)+RPLFM3.2*LOG(XPFM2(-1))
              +RPLFM3.3*LOG(FMCTO3)
              +RPLFM3.4*(IF YEARQ GE 19734 AND YEARQ LE 19743 THEN 1 ELSE 0)
              +RPLFM3.5*LOG(RPLFM3(-1))

NOB = 72       NOVAR = 6          NCOEF = 6        RANGE:  1971 1  TO  1988 4
RSQ = 0.9993   CRSQ =  0.9993     F(5/66) = 18980  PROB>F = 0.
SER = 1.162E-02 DW(0) = 1.629     COND = 633.381   LHS MEAN =   4.3508
```

COEF	ESTIMATE	TSTAT	MEAN	STDEV
RPLFM3.0	0.2793	8.7277	1.	0.
RPLFM3.1	0.8509	11.4006	3.5065	0.4049
RPLFM3.2	-0.4516	-5.4593	3.4889	0.4114
RPLFM3.3	0.1421	3.7916	4.4124	0.413
RPLFM3.4	-8.285E-02	-9.6557	5.556E-02	0.2307
RPLFM3.5	0.4711	7.9468	4.3326	0.4302

CONSUMER PRICE INDEX FOR CREAMERY BUTTER

```
LOG(RPCB3/RPCB3(-1)) = RPCB3.0+RPCB3.4*LOG(XWPCB3/XWPCB3(-1))
                       +RPCB3.5*LOG(XWPCB3(-1)/XWPCB3(-2))
                       +RPCB3.6*LOG(FMCTO3/FMCTO3(-1))

NOB = 68       NOVAR = 4          NCOEF = 4        RANGE:  1972 1  TO  1988 4
RSQ = 0.7675   CRSQ =  0.7566     F(3/64) = 70.43  PROB>F = 0.
SER = 1.074E-02 DW(0) = 3.1224    COND =  5.5919   LHS MEAN =  888E-02
```

COEF	ESTIMATE	TSTAT	MEAN	STDEV
RPCB3.0	5.031E-05	1.847E-02	1.	0.
RPCB3.4	0.5543	8.5439	1.801E-02	2.295E-02
RPCB3.5	0.5026	7.7193	1.812E-02	2.288E-02
RPCB3.6	-1.455E-02	-8.678E-02	1.776E-02	9.761E-03

CONSUMER PRICE INDEX FOR CHEDDAR CHEESE

```
LOG(RPCH3/RPCH3(-1)) = RPCH3.4*LOG(WPCH3/WPCH3(-1))+RPCH3.5*LOG(WPCH3(-1)/WPCH3(-2))
                       +RPCH3.7*LOG(FMCTO3/FMCTO3(-1))

NOB = 32       NOVAR = 3          NCOEF = 3        RANGE:  1980 1  TO  1987 4
RSQ = 0.8812   CRSQ =  0.873      F(3/29) =  NA    PROB>F = NA
SER = 9.104E-03 DW(0) = 1.2594    COND =  5.0739   LHS MEAN =  938E-02
```

COEF	ESTIMATE	TSTAT	MEAN	STDEV
RPCH3.4	9.849E-02	0.7865	1.503E-02	1.555E-02
RPCH3.5	0.8339	5.5953	1.549E-02	1.528E-02
RPCH3.7	0.2491	1.1267	1.536E-02	1.053E-02

CONSUMER PRICE INDEX FOR SKIM MILK POWDER

```
LOG(RPPM3) =    RPPM3.0+RPPM3.4*LOG(XWPPM3-XCSUP3/100)
                +RPPM3.5*LOG(XWPPM3(-1)-XCSUP3(-1)/100)
                +RPPM3.6*LOG(FMCTO3)

NOB = 32       NOVAR = 4          NCOEF = 4        RANGE:  1980 1  TO  1987 4
RSQ = 0.991    CRSQ =  0.99       F(3/28) =024.54  PROB>F = 0.
SER = 1.575E-02  DW(0) = 0.4631   COND =1126.83    LHS MEAN =   4.7676
```

COEF	ESTIMATE	TSTAT	MEAN	STDEV
RPPM3.0	-0.3549	-0.3676	1.	0.
RPPM3.4	-0.1593	-0.5691	0.9688	0.1245
RPPM3.5	0.2093	0.6921	0.9545	0.1358
RPPM3.6	1.068	4.1485	4.7539	0.1388

OTHER BLOCK:

CASH RECEIPTS FROM DAIRYING

```
CRDY3 = BCRDY3+CRDY3.0+CRDY3.1*SMFP3*XPFM2
              +(CRDY3.2+CRDY3.3*JS1+CRDY3.4*JS2+CRDY3.5*JS3)
              *(XNTM3-XSUM3)*SMMC3+CRDY3.6
              *JS3*(IF SUM(I = -4 TO -1 : SMMC3(I))
              -(XEDRM3(-1)+XSSPX3(-1)
              +XSPX3(-1)) GE 0 THEN (SUM(I = -4 TO -1 : SMMC3(I))
              -(XEDRM3(-1)+XSPX3(-1)))
              *(XPMM3(-1)-XIQM3(-1)) ELSE 0)
```

```
NOB = 32       NOVAR = 7          NCOEF = 7        RANGE:  1980 1  TO  1987 4
RSQ = 0.9797   CRSQ =  0.9749     F(6/25) =201.447 PROB>F = 0.
SER = 12.3207  DW(0) = 1.3966     COND =  45.91    LHS MEAN =  38.783
```

COEF	ESTIMATE	TSTAT	MEAN	STDEV
CRDY3.0	84.188	4.5645	1.	0.
CRDY3.1	0.5391	6.223	324.73	51.3845
CRDY3.2	1.0821	9.6276	371.707	62.362
CRDY3.3	-9.387E-02	-4.4523	85.1915	152.019
CRDY3.4	-0.1213	-3.2126	110.254	194.916
CRDY3.5	-2.217E-02	-0.8873	94.5893	167.334
CRDY3.6	-0.561	-1.9965	-1.4267	8.3136

SUPPLEMENTARY PAYMENTS TO MILK SHIPPERS

```
XCRDY3 = BXCRDY3+XCRDY3.0+(XCRDY3.1+XCRDY3.2*JS1+XCRDY3.3*JS2+XCRDY3.4*JS3)
               *XSUM3*SMMC3-XCRDY3.4*JS3
               *(IF SUM(I = -4 TO -1 : SMMC3(I))-(XEDRM3(-1)
               +XSSPX3(-1)) GE 0 THEN SUM(I = -4 TO -1 : SMMC3(I))
               -(XEDRM3(-1)+XSSPX3(-1))*XSUM3 ELSE 0)
```

```
NOB = 32       NOVAR = 5          NCOEF = 5        RANGE:  1980 1  TO  1987 4
RSQ = 0.8335   CRSQ =  0.8089     F(4/27) = 33.79  PROB>F = 0.
SER = 3.7963   DW(0) = 1.1349     COND =  47.0545  LHS MEAN =  68.6092
```

COEF	ESTIMATE	TSTAT	MEAN	STDEV
XCRDY3.0	55.3028	4.5037	1.	0.
XCRDY3.1	0.3254	1.6673	71.717	10.1656
XCRDY3.2	-0.2758	-9.2296	16.7161	29.4473
XCRDY3.3	-0.2306	-3.9523	21.6554	38.1777
XCRDY3.4	-7.853E-03	-0.7866	54.2827	111.685

FACTORY PRICE INDEX FOR DAIRY RATION:

FACTORY PRICE INDEX FOR DAIRY RATION
FPDR2 = FPDR2.0+FPDR2.1*JS1+FPDR2.2*JS2+FPDR2.3*JS3
+FPDR2.4*FPCO2+FPDR2.5*PSM2+FPDR2.6*FPDR2(-1)

NOB = 66 NOVAR = 7 NCOEF = 7 RANGE: 1971 1 TO 1987 2
RSQ = 0.9871 CRSQ = 0.9858 F(6/59) =755.15 PROB>F = 0.
SER = 7.5804 DW(0) = 2.4353 COND = 16.3063 LHS MEAN = 16.068

COEF	ESTIMATE	TSTAT	MEAN	STDEV
FPDR2.0	-4.298	-1.0479	1.	0.
FPDR2.1	2.3258	0.8798	0.2576	0.4407
FPDR2.2	-2.994	-1.1225	0.2576	0.4407
FPDR2.3	-2.6992	-0.9815	0.2424	0.4318
FPDR2.4	0.2562	5.2179	106.162	31.5963
FPDR2.5	7.897E-02	4.3932	237.337	67.5522
FPDR2.6	0.8195	33.6535	213.841	65.186